Appendix 1 – Consideration of Clause 228 factors

The table below demonstrates Transport for NSW's consideration of the specific factors identified within Clause 228 of the EP&A Regulation in determining whether the Proposal would have a significant impact on the environment.

Factor	Impacts
Any environmental impact on a community? The Proposal is not likely to generate unacceptable impacts on communities once operational. There may be some temporary impacts during construction, however mitigation measures have been identified to minimise these impacts.	☐ nil ☑ minor ☐ significant
Any transformation of a locality? The Proposal is not likely to transform a locality. The proposed use is consistent with existing uses.	☑ nil ☐ minor ☐ significant
Any environmental impact on the ecosystem of the locality? The Proposal is not likely to impact on the ecosystems of the locality provided the specified mitigation measures are implemented.	☑ nil ☐ minor ☐ significant
Any reduction of the aesthetic, recreational, scientific or other environmental quality or value of a locality? The Proposal is unlikely to reduce the aesthetic, recreational, scientific or other environmental quality or value of the locality once operational.	☐ nil ☑ minor ☐ significant
Any effect on a locality, place or building having aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or other special value for present or future generations? The Proposal is not likely to have a negative impact on a locality, place or building which have aesthetic, anthropological, archaeological, architectural, cultural, historical, scientific or social significance or any other value for present or future generations.	☐ nil ☑ minor ☐ significant
Any impact on the habitat of protected fauna (within the meaning of the National Parks and Wildlife Act 1974)? Impacts are not expected with the implementation of the specified mitigation measures.	☑ nil ☐ minor ☐ significant
Any endangering of any species of animal, plant or other form of life, whether living on land, in water or in the air? The assessment has found that no species would be endangered as a result of the Proposal.	☑ nil ☐ minor ☐ significant
Any long-term effects on the environment? It is unlikely that there would be long term effects on the environment. The Proposal would have an overall long term benefit by decreasing truck movements and decreasing GHG emissions.	☑ nil ☐ minor ☐ significant
Any degradation of the quality of the environment? Short term impacts are likely due to the construction activity. Mitigation measures would avoid these impacts.	☐ nil ☑ minor ☐ significant
Any risk to the safety of the environment?	☑ nil

Factor	Impacts
The Proposal would improve the safety by removing heavy vehicles from the road network.	☐ minor ☐ significant
Any reduction in the range of beneficial uses of the environment? It is unlikely that there would be a reduction in the range of beneficial uses of the environment.	☑ nil ☐ minor ☐ significant
Any pollution of the environment? Safeguards are to be implemented which would minimise any pollution of the environment.	☐ nil ☑ minor ☐ significant
Any environmental problems associated with the disposal of waste? Safeguards and mitigations measures are proposed. It is not expected that there would be any problems associated with the disposal of waste.	☐ nil ☑ minor ☐ significant
Any increased demands on resources (natural or otherwise) that are, or are likely to become, in short supply? Demand on resources is not expected.	☑ nil ☐ minor ☐ significant
Any cumulative environmental effect with other existing or likely future activities? There is unlikely to be current or future cumulative effects with existing or future activities.	☐ nil ☑ minor ☐ significant

Appendix 2 – Consideration of matters of national environmental significance

The table below demonstrates Transport for NSW's consideration of the matters of NES under the EPBC Act to be considered in order to determine whether the Proposal should be referred to the Commonwealth Department of the Environment and Energy.

Factor	Impacts
Any impact on a World Heritage property? The Proposal is not located near a World Heritage property.	☑ nil ☐ minor ☐ significant
Any impact on a National Heritage place? The Proposal is not located near a National Heritage place.	☑ nil ☐ minor ☐ significant
Any impact on a wetland of international importance? The Proposal is not located near a wetland of international importance.	☑ nil ☐ minor ☐ significant
Any impact on a listed threatened species or communities? The Proposal is not expected to impact on these species or their habitats.	☑ nil ☐ minor ☐ significant
Any impacts on listed migratory species? The Proposal is not expected to impact on these species or their habitats.	☑ nil ☐ minor ☐ significant
Any impact on a Commonwealth marine area? The Proposal is not located near a Commonwealth marine area.	☑ nil ☐ minor ☐ significant
Does the Proposal involve a nuclear action (including uranium mining)? The Proposal does not involve a nuclear action.	☑ nil ☐ minor ☐ significant
Additionally, any impact (direct or indirect) on Commonwealth land? No direct or indirect impact to Commonwealth land is expected.	☑ nil ☐ minor ☐ significant

Appendix 3 – Traffic Impact Assessment

Technical Memorandum

Title	**Spoil Management Pathway Project Traffic Assessment**		
Client	Transport for New South Wales	**Project No**	8201702802
Date	18/01/2017	**Status**	Version C
Author	Aaron Pau / Tom Yang	**Discipline**	Traffic and Transport
Reviewer	Ivo Pais	**Office**	Sydney

1 Background

The Spoil Management Pathway Project will establish an integrated transport path to transfer Virgin Excavated Natural Material from the Westconnex M4 and M5 excavations (herein referred to as 'work sites') to civil construction projects in the Illawarra Region.

A schematic of the proposed transportation route and the potential opportunities was presented by Transport for NSW and has been reproduced in **Figure 1**.

Figure 1 Proposed Transportation Route Schematic and Opportunities

Source: Transport for NSW Spoil Management Presentation

On the above basis, Cardno (NSW / ACT) Pty Ltd has been commissioned by Transport for NSW to assess the traffic impacts in terms of road network capacity as a result of the additional trucks on the road network transporting the spoil from the works site to Chullora Rail Depot, and from Commonwealth Rolling Mills (CRM) site at Port Kembla to civil construction projects in the Illawarra Region.

2 Proposed Operation

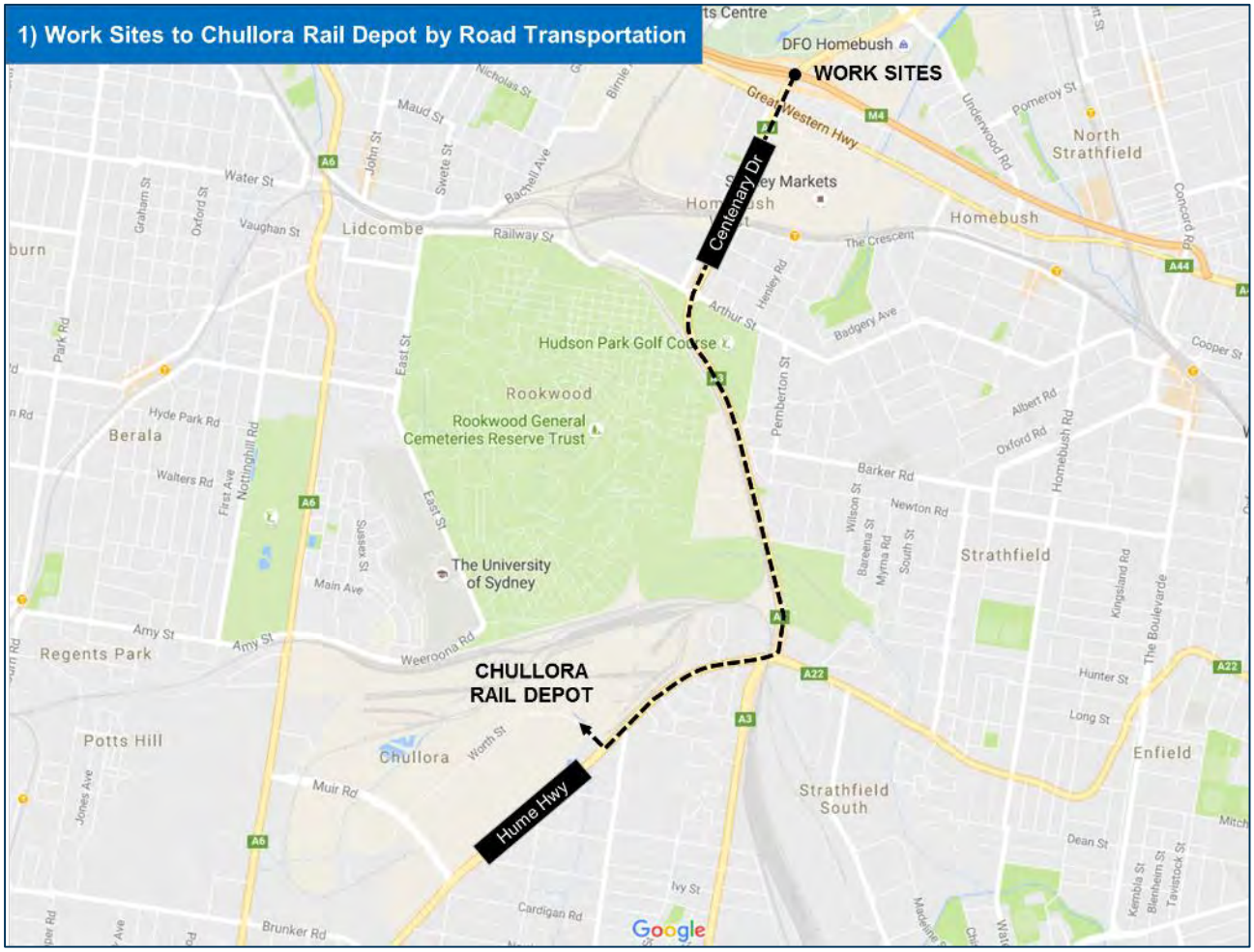
Spoil transport routes from the extraction site to Chullora would be carried out by the project that is extracting the spoil. Movements would be approved via that project's specific spoil and transport management plan. This assessment has assumed the most likely route to be taken to the transfer facility from the surrounding major roads. Therefore, it is pertinent to note that this study assumes that all spoil removal trucks will enter / exit the work sites to / from Centenary Drive satisfactorily, and therefore how these trucks travel to / from Centenary Drive is outside the scope of this project.

2.1 Work Sites to Chullora Rail Depot

All trucks travelling from the work sites to the Chullora Rail Depot will travel along the following routes as illustrated in **Figure 2**:

- From M4 Motorway, all trucks will travel southbound along Centenary Drive towards Hume Highway.
- At the Centenary Drive / Hume Highway intersection, all trucks will turn right and travel westbound towards Worth Street.
- At the Hume Highway / Worth Street intersection, all trucks will turn right onto Worth Street.
- From Worth Street, spoil removal trucks will then turn into the Chullora Rail Depot to deliver the payload.
- All trucks are then to return to the work sites following the same route.

Figure 2 Work Sites to Chullora Rail Depot



Background Image: Google Maps

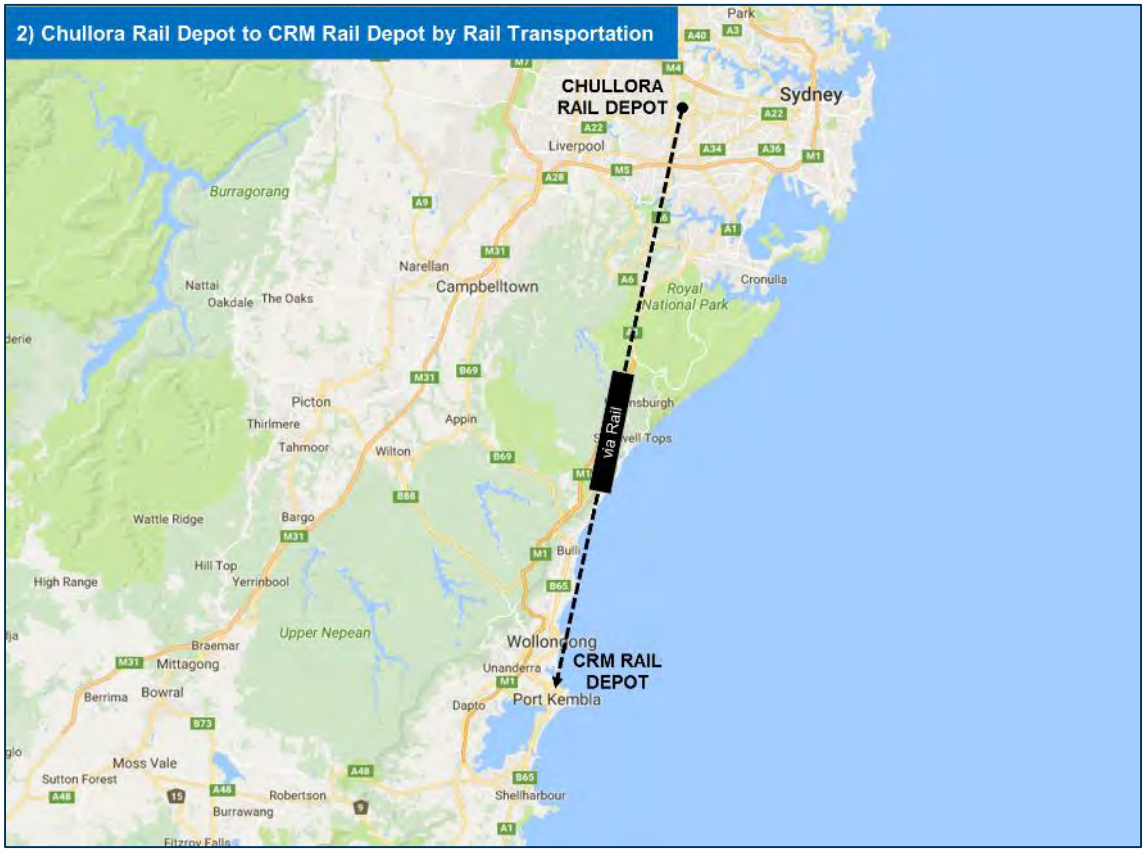
Further to the above, Cardno has also undertaken a review of the Restricted Access Vehicle (RAV) map published on Roads and Maritime's website (attached in **Appendix A**), which indicates Centenary Drive,

Hume Highway and Worth Street along the proposed travel route from the works sites to the Chullora Rail Depot are all gazetted as 25/26m B-double routes.

2.2 Chullora Rail Depot to CRM Rail Depot

All spoil delivered to the Chullora Rail depot will be transported to CRM Rail Depot via rail, as illustrated in **Figure 3**.

Figure 3 Chullora Rail Depot to CRM Rail Depot



Background Image: Google Maps

2.3 CRM Rail Depot to Wider Illawarra Region

All trucks travelling from the CRM rail depot to civil construction projects in the Illawarra Region will travel along the following routes as illustrated in **Figure 4**:

- From CRM rail depot, all trucks are expected to turn left onto Old Port Road and then travel along Flinders Street to approach the Five Islands Road / Flinders Street intersection.
- From Five Islands Road / Flinders Street intersection, all trucks travelling to the southern areas of Illawarra Region are expected to travel southbound along Five Islands Road and then onto King Street.
- From Five Islands Road / Flinders Street intersection, all trucks travelling to the western and south-western areas of Illawarra Region is expected to travel northbound along Five Islands Road and turn left onto Princes Motorway.
- From Five Islands Road / Flinders Street intersection, all trucks travelling to the northern areas of the Illawarra Region will need to travel northbound along Five Islands Road and turn right either onto Springhill Road or Princes Motorway subject to its destination.
- All trucks are then to return to the CRM rail depot following the same route.
- It is noted that there may be opportunities to transport spoil to certain work sites by rail from the CRM rail depot to other rail depots in the Illawarra Region, though this has not been considered as part of this traffic assessment.

Figure 4 CRM Rail Depot to Wider Illawarra Region

Background Image: Google Maps

Further to the above, Cardno has also undertaken a review of the RAV map published on Roads and Maritime's website (attached in **Appendix A**), which indicates Old Port Road, Flinders Street, Five Islands Road, King Street, Springhill Road and Princes Motorway along the proposed travel route from the CRM rail depot to the wider Illawarra region are all gazetted as 25/26m B-double routes.

2.4 Number of Truck Movements

The total number of truck movements (one-way) has been supplied by Transport for NSW which will comprise 255 truck movements per day, undertaken in three campaigns to coincide with train arrivals as follows:

- Early Morning: 85 truck movements
- Lunchtime: 85 truck movements
- Late Afternoon: 85 Truck movements

It is further understood that each campaign will comprise a 3 hour shift and all outbound truck movements are expected to return to its origin in the same hour. Accordingly, the expected number of additional truck movements during the AM and PM peak hour will be approximately 28 trips in each direction or 56 trips in total.

Cardno has also been advised that the truck fleet will likely comprise 14 truck and dogs in total, and has been conservatively assumed to correspond to 3.6 passenger car units (pcu). This figure is normally adopted for B-Double vehicles.

2.5 Truck Distribution

All trucks travelling between the work sites and Chullora Rail Depot will follow the nominated truck route illustrated in **Figure 2**.

All trucks travelling from the CRM Rail Depot to the wider Illawarra Region will follow the nominated truck route illustrated in **Figure 4** assuming that 50% of trucks will travel southbound along Five Islands Road

and the other 50% trucks travel northbound along Five Islands Road. Further, all outbound trucks are assumed to return to its origin following the same route.

Accordingly, the increase in number of truck movements at key intersections in the AM and PM peak hour as a result of the Spoil Management Pathway Project is illustrated in **Figure 5**, **Figure 6**, **Figure 7** and **Figure 8**.

Figure 5 AM Peak Hour: Additional Truck Movements near Chullora Rail Depot

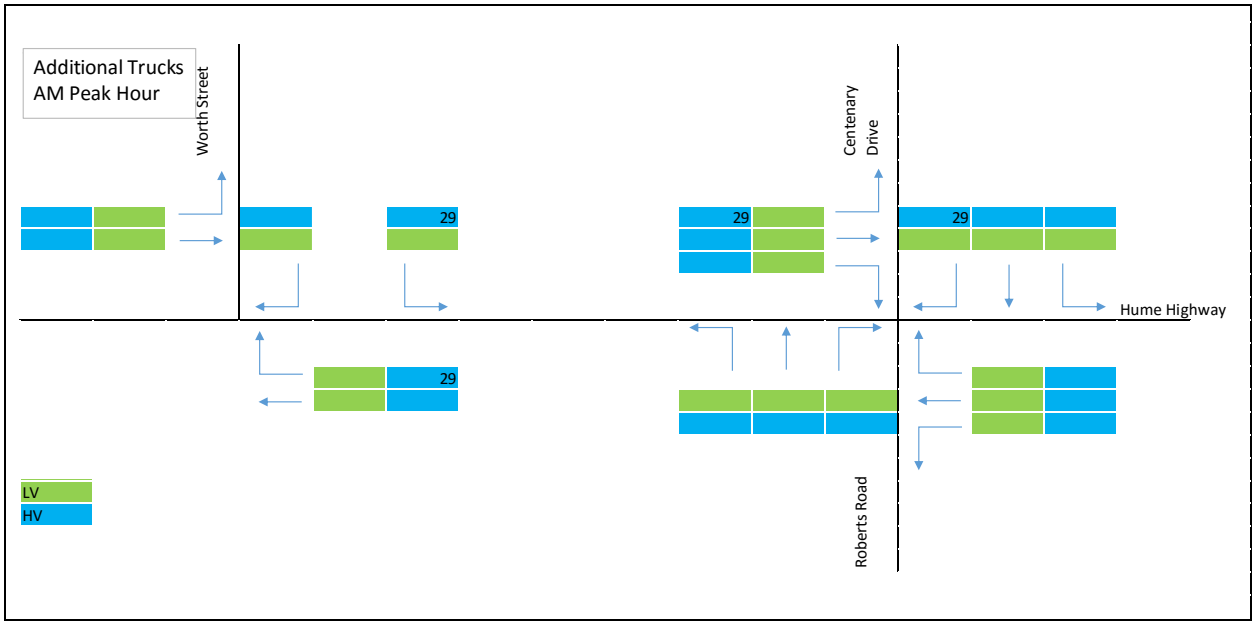


Figure 6 PM Peak Hour: Additional Truck Movements near Chullora Rail Depot

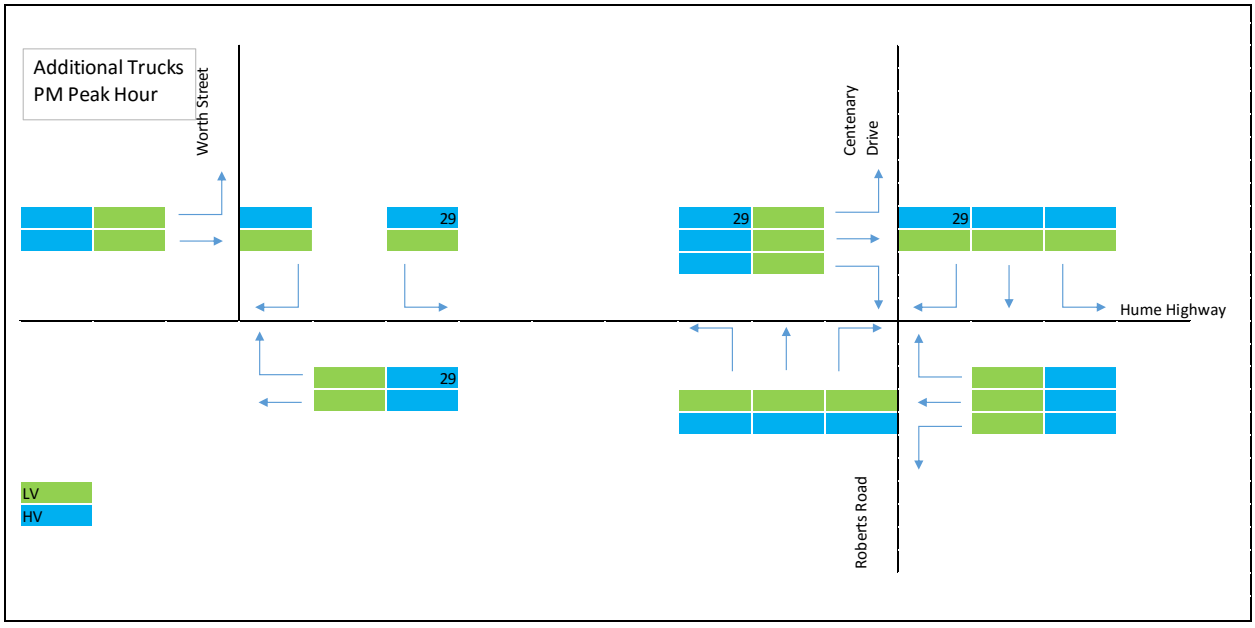


Figure 7 AM Peak Hour: Additional Truck Movements near CRM Rail Depot

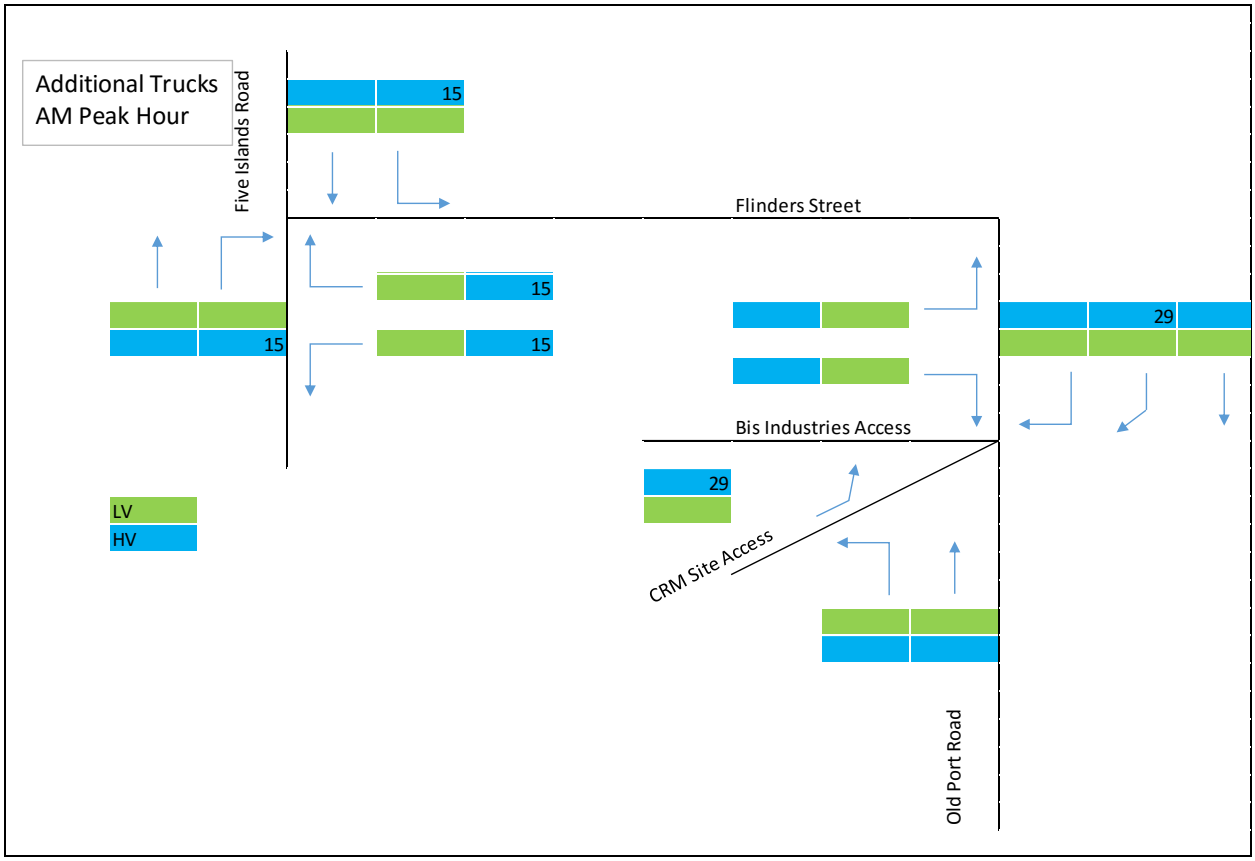
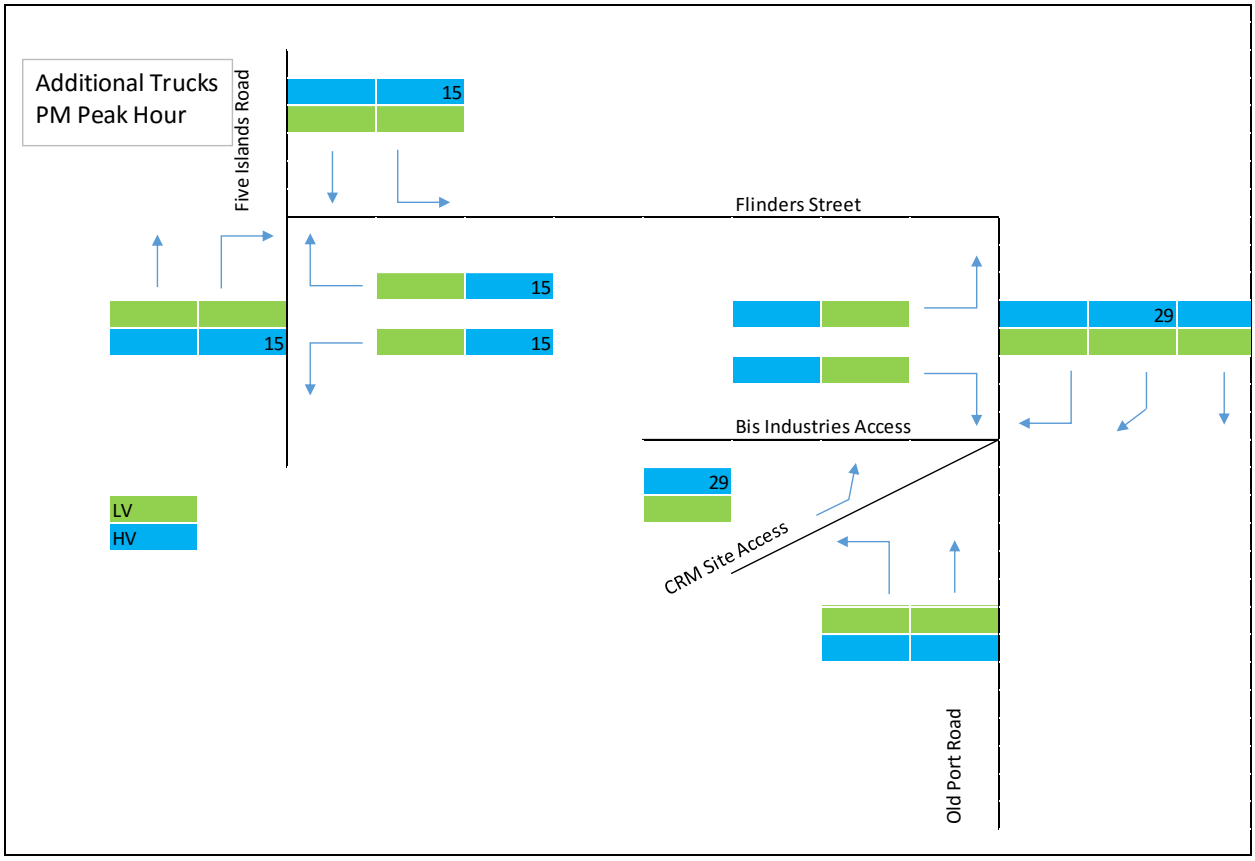


Figure 8 PM Peak Hour: Additional Truck Movements near CRM Rail Depot



3 Traffic Impact Assessment

3.1 Mid-Block Assessment

The existing peak hour traffic volumes along Centenary Drive and Five Islands Road have been extracted from the Roads and Maritime's count stations at the following locations for the year of 2016 (accessed on 13 December 2016):

- 80m east of Richmond Road, Homebush (Station ID: 28008)
- 200m north of Hume Highway, Strathfield (Station ID: 288009)
- 140m east of Lake Avenue, Spring Hill (Station ID: 07097)

In order to provide an indication of the wider road network impacts along the proposed travel routes as a result of the Spoil Management Pathway Project, **Table 2** has been set out to compare the additional truck movements and the existing traffic volumes recorded on the road network.

Table 2 Mid-Block Traffic Volume Comparison

Scenario	Direction	AM Peak Hour			PM Peak Hour		
		Existing Traffic Volume	Additional Traffic Volume	% increase	Existing Traffic Volume	Additional Traffic Volume	% increase
Centenary Drive between Arthur Street and Hume Highway							
2016	NB	2,469	29	1.2%	2,715	29	1.1%
	SB	2,170	29	1.3%	2,907	29	1.0%
	TOTAL	4,639	57	1.2%	5,623	57	1.0%
Centenary Drive between Parramatta Road and Arthur Street							
2016	NB	3,228	29	0.9%	2,401	29	1.2%
	SB	3,329	29	0.9%	3,486	29	0.8%
	TOTAL	6,557	57	0.9%	5,887	57	1.0%
Five Islands Road between Springhill Road and Flinders Street							
2016	NB	1,963	29	1.5%	1,932	29	1.5%
	SB	1,324	29	2.2%	1,855	29	1.6%
	TOTAL	3,287	57	1.7%	3,787	57	1.5%

Based on the above comparison, it is clear that the increase in traffic volumes along the proposed travel routes is generally less than 2% increase in the total traffic volumes, and therefore could not be expected to have any tangible negative impacts in terms of road network capacity.

3.2 Intersection Operation

In order to supplement the findings of the mid-block assessment, vehicle turning movement surveys were undertaken between 7:00am-9:00am and 4:30pm-6:30pm on 23 November 2016 at the following four (4) intersections:

- Hume Highway / Worth Street Intersection (**Figure 9**)
- Hume Highway / Centenary Drive / Roberts Road Intersection (**Figure 10**)
- Five Islands Road / Flinders Street Intersection (**Figure 11**)
- Old Port Road / Bis Industries Access / CRM Access Intersection (**Figure 12**)

The full set of survey results and existing vehicle turning flows have been reproduced in **Appendix B**.

Accordingly, the subsequent sections review the existing intersection operation at the above-nominated locations and compares that with the intersection operation when the additional truck movements are included in the road network to provide a more detailed overview of the existing road network operation along the proposed travel routes. The combined AM and PM peak hour vehicle turning flows used in the intersection analysis including the additional trucks as a result of the Spoil Management Pathway Project are attached in **Appendix C**.

Figure 9 Hume Highway / Worth Street Intersection

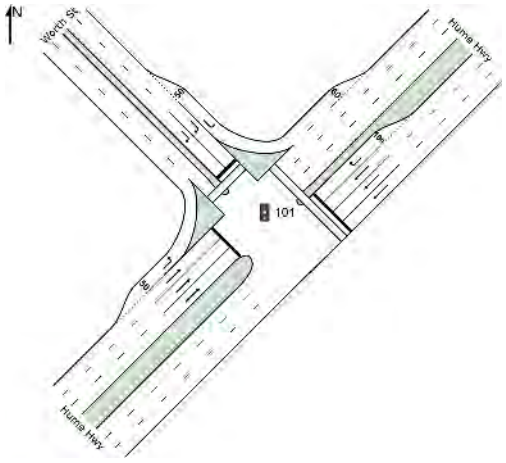


Figure 10 Hume Highway / Centenary Drive / Roberts Road Intersection

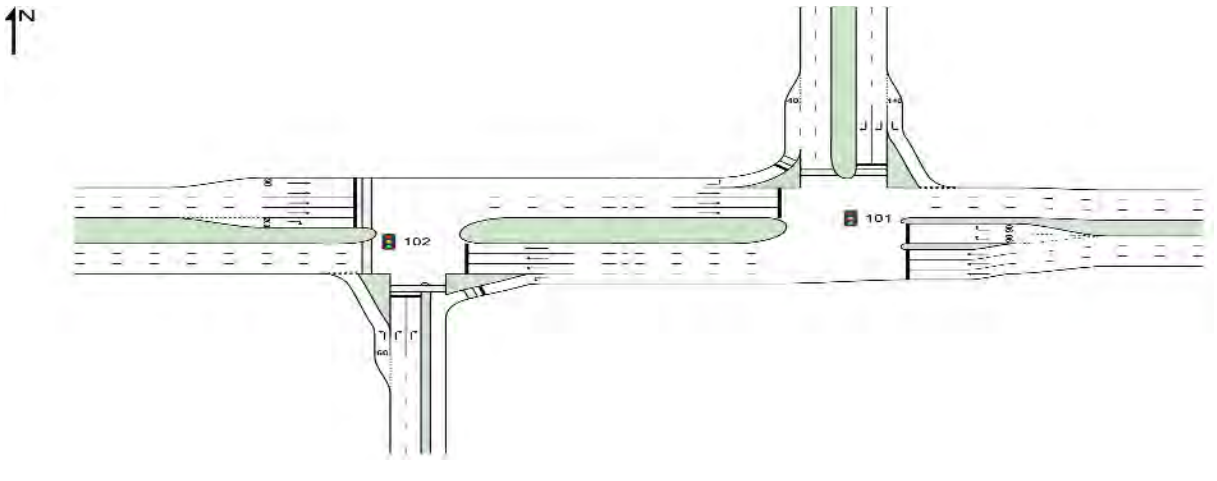


Figure 11 Five Islands Road / Flinders Street Intersection

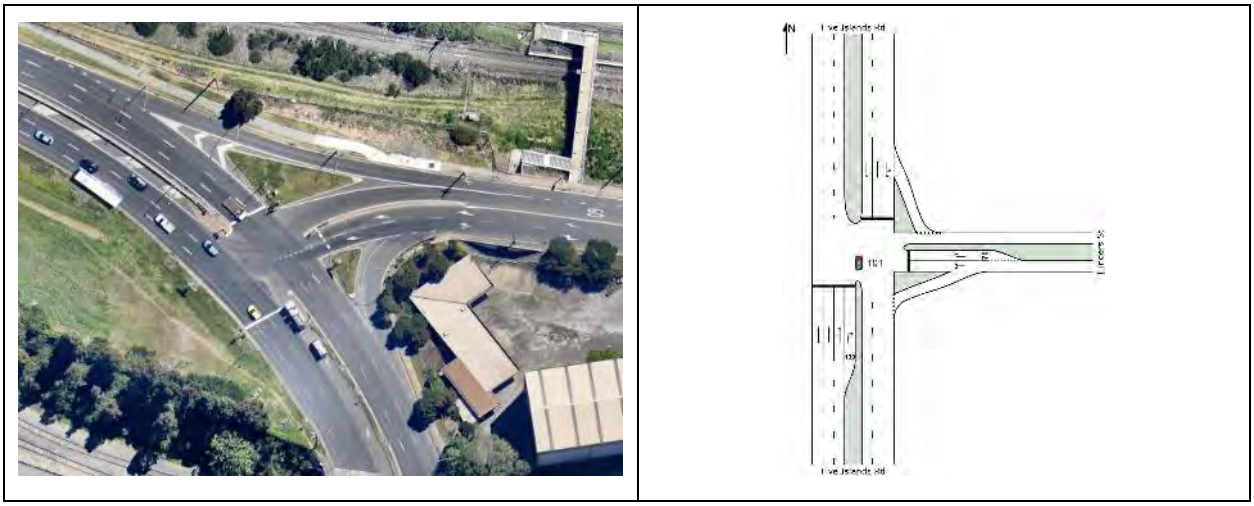
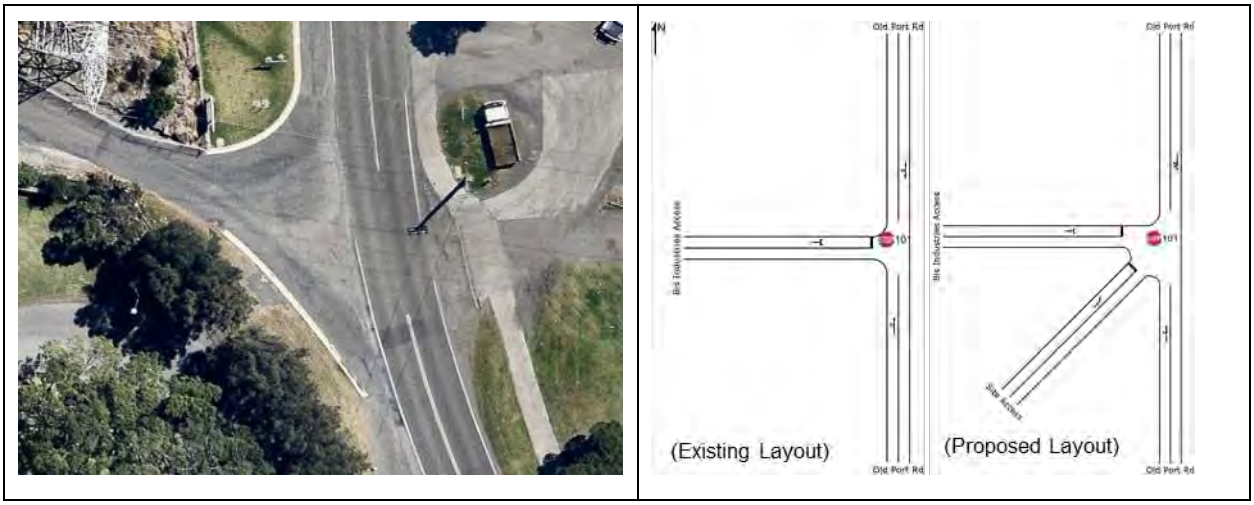


Figure 12 Old Port Road / Bis Industries Access / CRM Access Intersection



3.3 Level of Service Criteria for Intersections

The key indicator of intersection performance is typically the Level of Service (LoS), where results are placed on a scale from 'A' to 'F', outlined in **Table 3**.

Table 3 Level of Service Criteria for Intersections

Level of Service	Average Delay per Vehicle (sec/veh)	Traffic Signals, Roundabout	Giveway & Stop Signs
A	< 14	Good Operation	Good Operation
B	15 to 28	Good with acceptable delays and spare capacity	Acceptable delays and spare capacity
C	29 to 42	Satisfactory	Satisfactory, but accident study required
D	43 to 56	Operating near capacity	Near Capacity & accident study required
E	57 to 70	At Capacity, at signals incidents will cause excessive delays Roundabouts require other control mode	At capacity, requires other control mode
F	> 70	Unsatisfactory and requires additional capacity.	Unsatisfactory and requires additional capacity.

Source: Guide to Traffic Generating Developments (Roads and Maritime, 2002)

The Average Vehicle Delay (AVD) provides a measure of the operational performance of an intersection and determines the LoS when applying the Roads and Maritime method. It should be noted that the AVD's should be taken as a guide only as longer delays could be tolerated in some locations (i.e. inner city conditions) and on some roads (i.e. minor side street intersecting with a major arterial route). For traffic signals, the weighted average delay over all movements should be utilised. For roundabouts and

priority control intersections (sign control) the critical movement for assessing LoS should be the movement with the highest average delay.

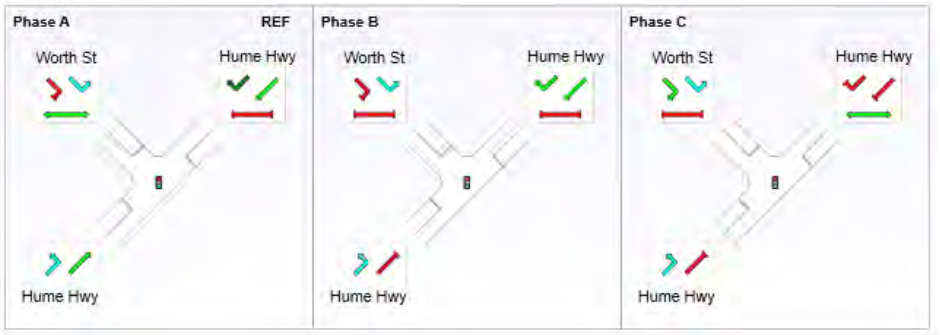
The Degree of Saturation (DoS) is another measure of the operational performance of individual intersections. For intersections controlled by traffic signals, both queue length and delay increase rapidly as DOS approaches 1.0. It is usual to attempt to keep DOS to less than 0.9. Degrees of Saturation in the order of 0.7 generally represent satisfactory intersection operation. When DOS exceed 0.9 queues can be anticipated.

3.3.1 Hume Highway / Worth Street Intersection

The operation of the Hume Highway / Worth Street intersection has been assessed using SIDRA 7.0 with and without the additional truck movements as a result of the Spoil Management Pathway Project.

The phasing sequence of the intersection has been modelled in accordance with the TCS No. 1269 supplied by the Roads and Maritime, and is illustrated in **Figure 13** modelled with a cycle time of 140 seconds.

Figure 13 Hume Highway / Worth Street Intersection Phase Sequence



Accordingly, the SIDRA results are summarised in **Table 4**, indicating that there will be minimal impact on the Hume Highway / Worth Street intersection as a result of the Spoil Management Pathway Project, where the intersection will continue to operate at satisfactory LoS C or better.

Table 4 Hume Highway / Worth St Intersection SIDRA Summary

Scenario	AM Peak			PM Peak		
	DoS	Delay (sec)	LoS	DoS	Delay (sec)	LoS
Existing	0.808	24.1	B	0.749	22.9	B
Existing + Additional Trucks	0.900	31.7	C	0.859	27.7	B

The full set of the SIDRA movement summaries are reproduced in **Appendix D**.

3.3.2 Hume Highway / Centenary Drive / Roberts Road Intersection

The operation of the Hume Highway / Centenary Drive / Roberts Road Intersection has been assessed using SIDRA 7.0 with and without the additional truck movements as a result of the Spoil Management Pathway Project.

Given the configuration of the intersection, it has been modelled as a staggered T-intersection using SIDRA 7.0's network function.

The phasing sequence of the intersection has been modelled in accordance with the TCS No. 1442 supplied by the Roads and Maritime, and is illustrated in **Figure 14** modelled with a SIDRA's default practical cycle time.

Figure 14 Hume Highway / Centenary Drive / Roberts Road Intersection Phase Sequence

Accordingly, the SIDRA results are summarised in **Table 5**.

Table 5 Hume Highway / Centenary Drive / Roberts Road Intersection SIDRA Summary

Scenario	AM Peak			PM Peak		
	DoS	Delay (sec)	LoS	DoS	Delay (sec)	LoS
Western T-Intersection – Hume Highway / Roberts Road						
Existing	1.642	170.9	F	1.374	211.2	F
Existing + Additional Trucks	1.642	174.3	F	1.308	215.7	F
Eastern T-Intersection – Hume Highway / Centenary Drive						
Existing	1.467	119.9	F	0.975	18.4	B
Existing + Additional Trucks	1.759	183.3	F	1.380	67.1	E
Overall Network Level of Service						
Existing	**F**			**F**		
Existing + Additional Trucks	**F**			**F**		

On the basis of the above SIDRA results, the intersection currently operates at a LoS F in both the AM and PM peak hour, and will continue to operate at LoS F with the additional trucks.

Further to the above, a detailed review of the SIDRA movement summaries was undertaken (attached in **Appendix D**), revealing that:

- The Hume Highway approaches are generally operating satisfactorily at LOS D or better with moving queues within the available road storage space.
- The Centenary Drive and Roberts Road approaches are exceeding capacity with queues up to 900m.

Notwithstanding the above, it was previously mentioned that the total increase in traffic volumes as a consequence of the proposal is generally less than 2% and is clearly not the primary contributing factor to the poor service levels of the intersection.

In terms of the proposed operation of the spoil removal however, it would be recommended to drive between the works sites and Chullora Rail Depot at the nominated operational times on different days of the week to record the actual travel times so that the schedule of the transportation of spoil between the work sites and Chullora Rail Depot can be better planned based on actual data (i.e. have more confidence in actual travel times to ensure that the trucks arrive at their destination on time with typical congestion levels).

3.3.3 Five Islands Road / Flinders Street Intersection

The operation of the Five Islands Road / Flinders Street Intersection has been assessed using SIDRA 7.0 with and without the additional truck movements as a result of the Spoil Management Pathway Project.

The phasing sequence of the intersection has been modelled in accordance with the TCS No. 0608 supplied by the Roads and Maritime, and is illustrated in **Figure 15** modelled with SIDRA's default practical cycle time.

Figure 15 Five Islands Road / Flinders Street Intersection Phase Sequence

Accordingly, the SIDRA analysis results are summarised in **Table 6**, indicating that there will be minimal impact on the Five Islands Road / Flinders Street intersection as a result of the Spoil Management Pathway Project, where the intersection will continue to operate at satisfactory LoS B or better.

Table 6 Five Islands Road / Flinders Street Intersection SIDRA Summary

Scenario	AM Peak			PM Peak		
	DoS	Delay (sec)	LoS	DoS	Delay (sec)	LoS
Existing	0.752	12.3	A	0.807	15.0	B
Existing + Additional Trucks	0.803	14.3	A	0.874	20.2	B

3.3.4 Old Port Road / Bis Industries Access / CRM Access Intersection

The operation of the Old Port Road / Bis Industries Access / CRM Access Intersection has been assessed using SIDRA 7.0 with and without the additional truck movements as a result of the Spoil Management Pathway Project.

It is pertinent to note that the proposed access / egress to and from the CRM Rail Depot is currently an emergency only access at the intersection. Cardno has been advised that this access has been nominated to entry/exit point to the site. The considerations below focus on the capacity of such a configuration to cater for the additional movements. However, it must be noted that the proposed access poses some alignment and safety concerns which is outside the scope of this study.

From a traffic safety perspective, it would be preferred to use an alternative access to the site (further south on Old Port Road) or identify suitable mitigation measures which could potentially include one or a combination of the following:

- Station a permanent Roads and Maritime accredited Traffic Controller to assist truck's entering and exiting the site.
- Intersection realignment.
- Intersection signalisation.

Accordingly, the SIDRA analysis results are summarised in **Table 7**, indicating that there will be minimal impact on the Old Port Road / Bis Industries Access / CRM Access intersection as a result of the Spoil Management Pathway Project, where the intersection will continue to operate at satisfactory LoS A or better.

Table 7 Old Port Road / Site Access Intersection SIDRA Summary

Scenario	AM Peak			PM Peak		
	DoS	Delay (sec)	LoS	DoS	Delay (sec)	LoS
Existing	0.075	6.5	A	0.037	5.6	A
Existing + Additional Trucks	0.155	3.1	A	0.109	3.6	A

4 Conclusion

Cardno (NSW / ACT) Pty Ltd has been commissioned by Transport for NSW to assess the traffic impacts in terms of road network capacity as a result of the additional trucks on the road network transporting the spoil from Westconnex M4 and M5 excavations to Chullora Rail Depot, and from Commonwealth Rolling Mills (CRM) site at Port Kembla to civil construction projects in the Illawarra Region.

Based on the analysis and discussions presented in this Technical Memorandum, the following conclusions are made:

- Based on operational information provided by Transport for NSW, the expected number of additional truck movements during the AM and PM peak hour will be approximately 28 trips in each direction or 56 trips in total.
- The truck fleet is expected to be comprised of Truck and Dogs only and has been conservatively assumed to correspond to 3.6 pcu.
- The increase in traffic volumes along the proposed travel routes is generally less than 2% increase in the total traffic volumes, and therefore could not be expected to have any tangible negative impacts in terms of road network capacity.
- Cardno undertook a detailed review of four (4) key intersections along the proposed travel route using SIDRA 7.0, revealing that:
  - There will be minimal impact on the Hume Highway / Worth Street intersection as a result of the Spoil Management Pathway Project, where the intersection will continue to operate at satisfactory LoS C or better
  - There will be minimal impact on the Hume Highway / Centenary Drive / Roberts Road intersection which currently operates at a LoS F in both the AM and PM peak hour. Although, the intersection will continue to operate at LoS F with the additional truck movement, it is noted that the total increase in traffic volumes as a consequence of the proposal is generally less than 2% and is clearly not the primary contributing factor to the poor service levels of the intersection.
  - There will be minimal impact on the Five Islands Road / Flinders Street intersection as a result of the Spoil Management Pathway Project, where the intersection will continue to operate at satisfactory LoS B or better.
  - There will be minimal impact on the Old Port Road / Bis Industries Access / CRM Access intersection as a result of the Spoil Management Pathway Project, where the intersection will continue to operate at satisfactory LoS A or better.

It is pertinent to note that the proposed access / egress to and from the CRM Rail Depot is currently an emergency only access at the intersection. Cardno has been advised that this access has been nominated to entry/exit point to the site. The considerations in this assessment primarily focuses on the capacity of such a configuration to cater for the additional movements. However, it must be noted that the proposed access poses some alignment and safety concerns which is outside the scope of this study.

From a traffic safety perspective, it would be preferred to use an alternative access to the site (further south on Old Port Road) or identify suitable mitigation measures which could potentially include one or a combination of the following:

- Station a permanent Roads and Maritime accredited Traffic Controller to assist truck's entering and exiting the site.
- Intersection realignment.
- Intersection signalisation.

In terms of the proposed operation of the spoil removal however, it would be recommended to drive between the works sites and Chullora Rail Depot at the nominated operational times on different days of the week to record the actual travel times so that the schedule of the transportation of spoil between the work sites and Chullora Rail Depot can be better planned based on actual data (i.e. have more confidence in actual travel times to ensure that the trucks arrive at their destination on time with typical congestion levels).

Spoil Management Pathway Project

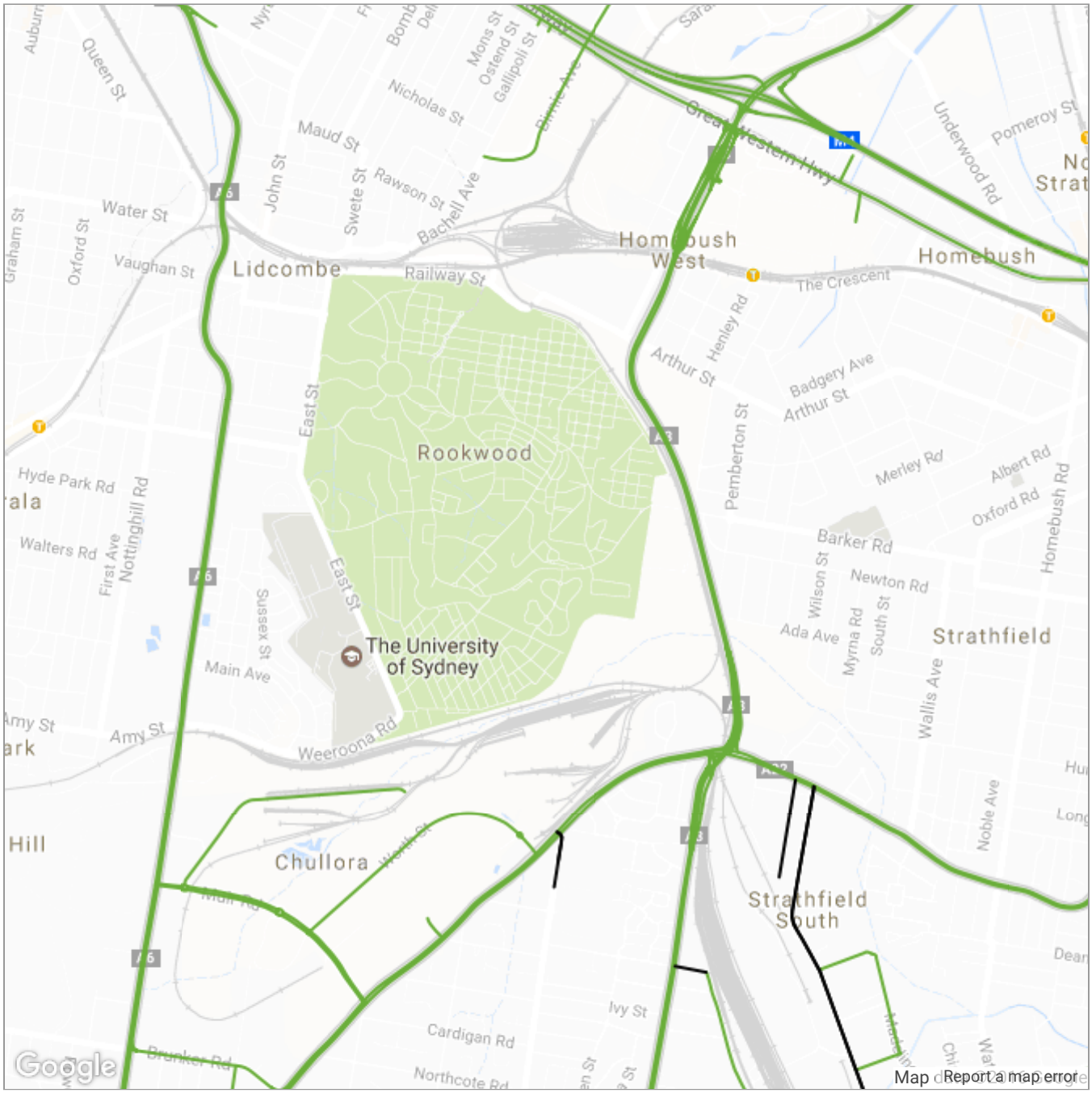
Appendix A

RAV MAPS

Cardno
Shaping the Future

NSW Combined Higher Mass Limits (HML) and Restricted Access Vehicle (RAV) Map

Map last updated: 07/12/2016



Legend

GML and CML networks

- 25/26m B-double Routes
- Approved Routes With Travel Conditions
- Exception Routes (not approved)
- Approved Areas
- Approved Areas with Travel Conditions
- Restricted Structures - Intersections
- Restricted Structures - Intersections with Conditional Access
- Low Clearance Bridge (< 4.3m) - Through Traffic on Bridge
- Low Clearance Bridge (< 4.3m) - Through Traffic under Bridge

Network Disclaimer

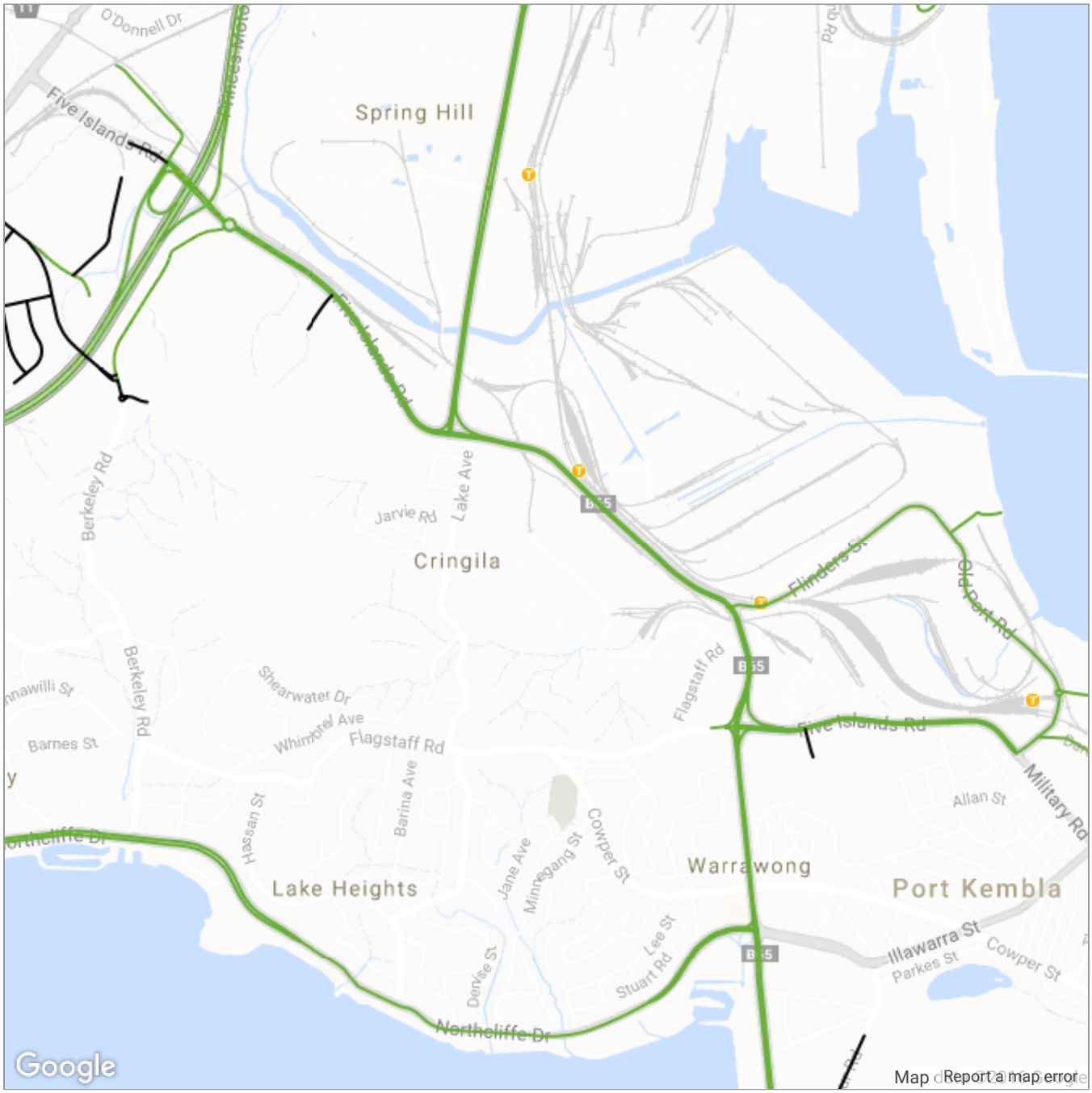
The networks are available for short combinations (up to 19 metres long) and B-doubles that comply with the requirements contained in the Heavy Vehicle National Law (HVNL); the National Class 2 Heavy Vehicle B-double Authorisation (Notice) and the adjoining NSW Schedule and for Higher Mass Limits (HML) the New South Wales Higher Mass Limits Declaration 2015. These networks are based on a maximum vehicle width of 2.5 metres and are subject to sign-posted restrictions.

Provide feedback

Contact Roads and Maritime Services | Phone: 131 782

NSW Combined Higher Mass Limits (HML) and Restricted Access Vehicle (RAV) Map

Map last updated: 07/12/2016



Legend

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Provide feedback

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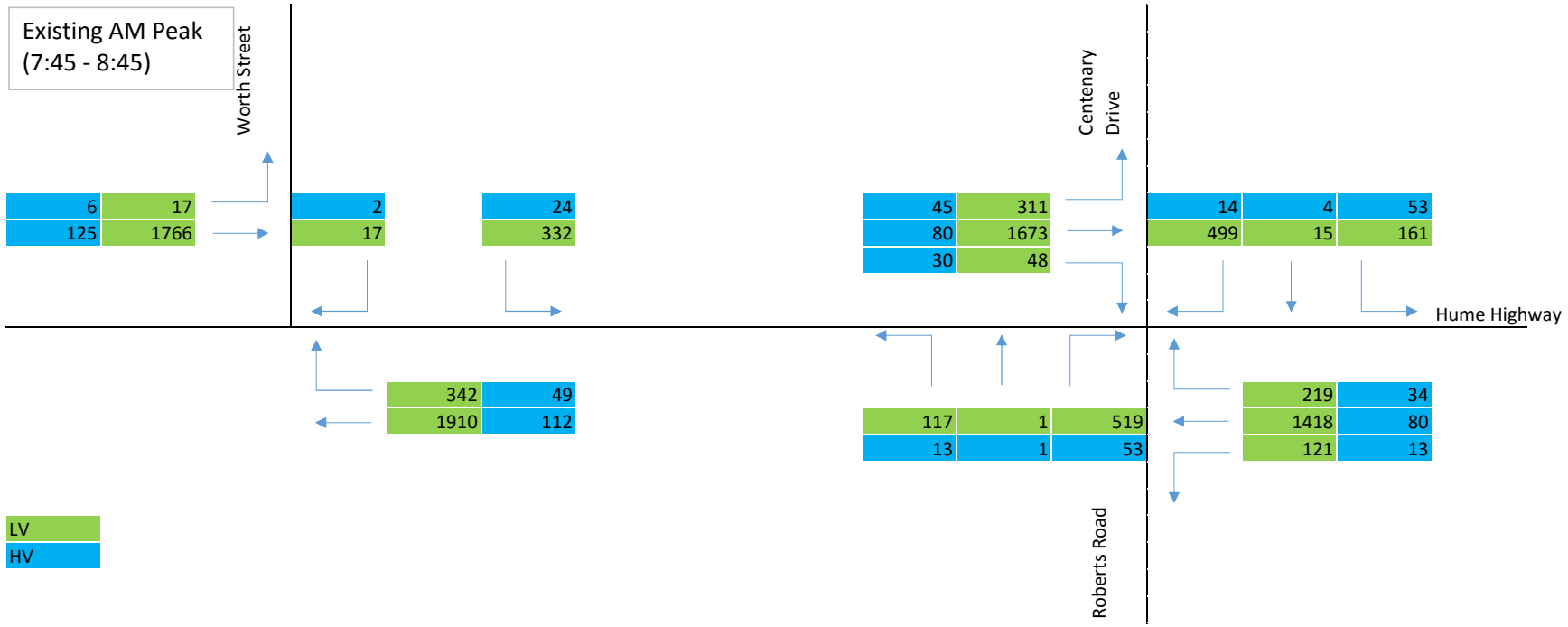
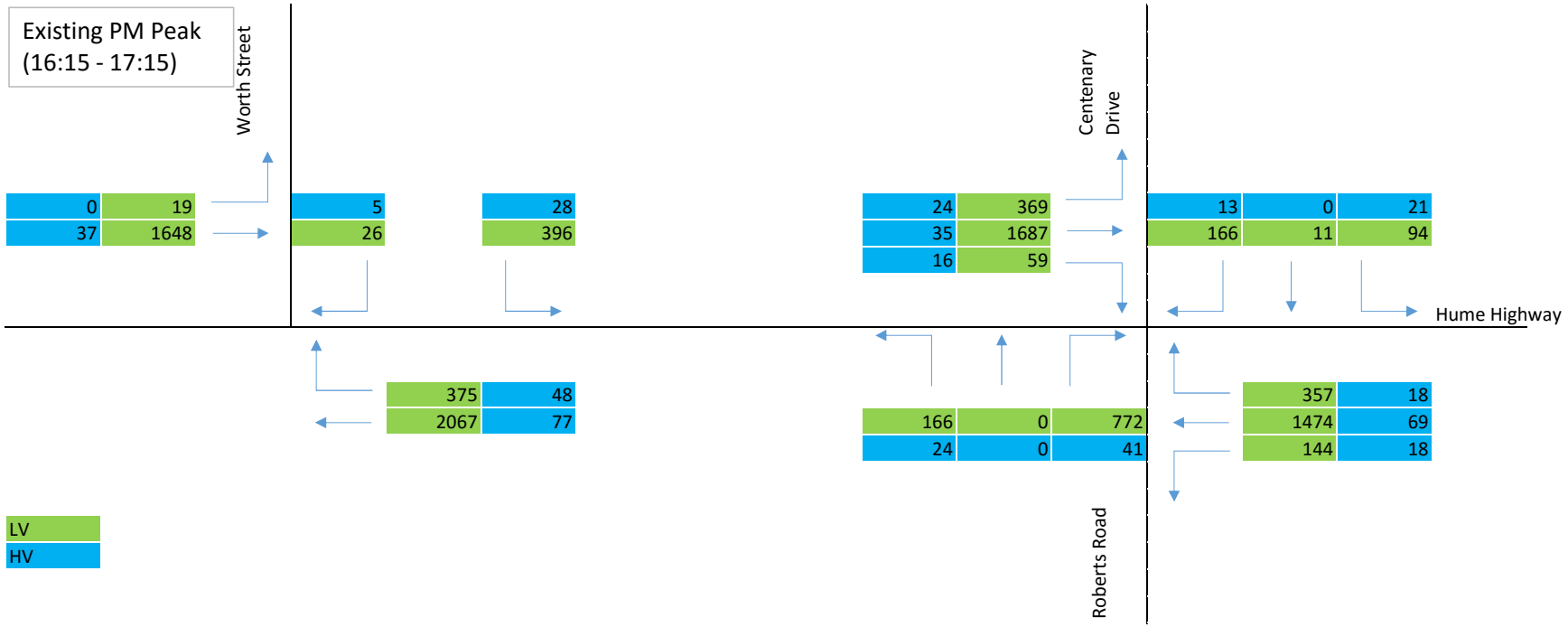
Spoil Management Pathway Project

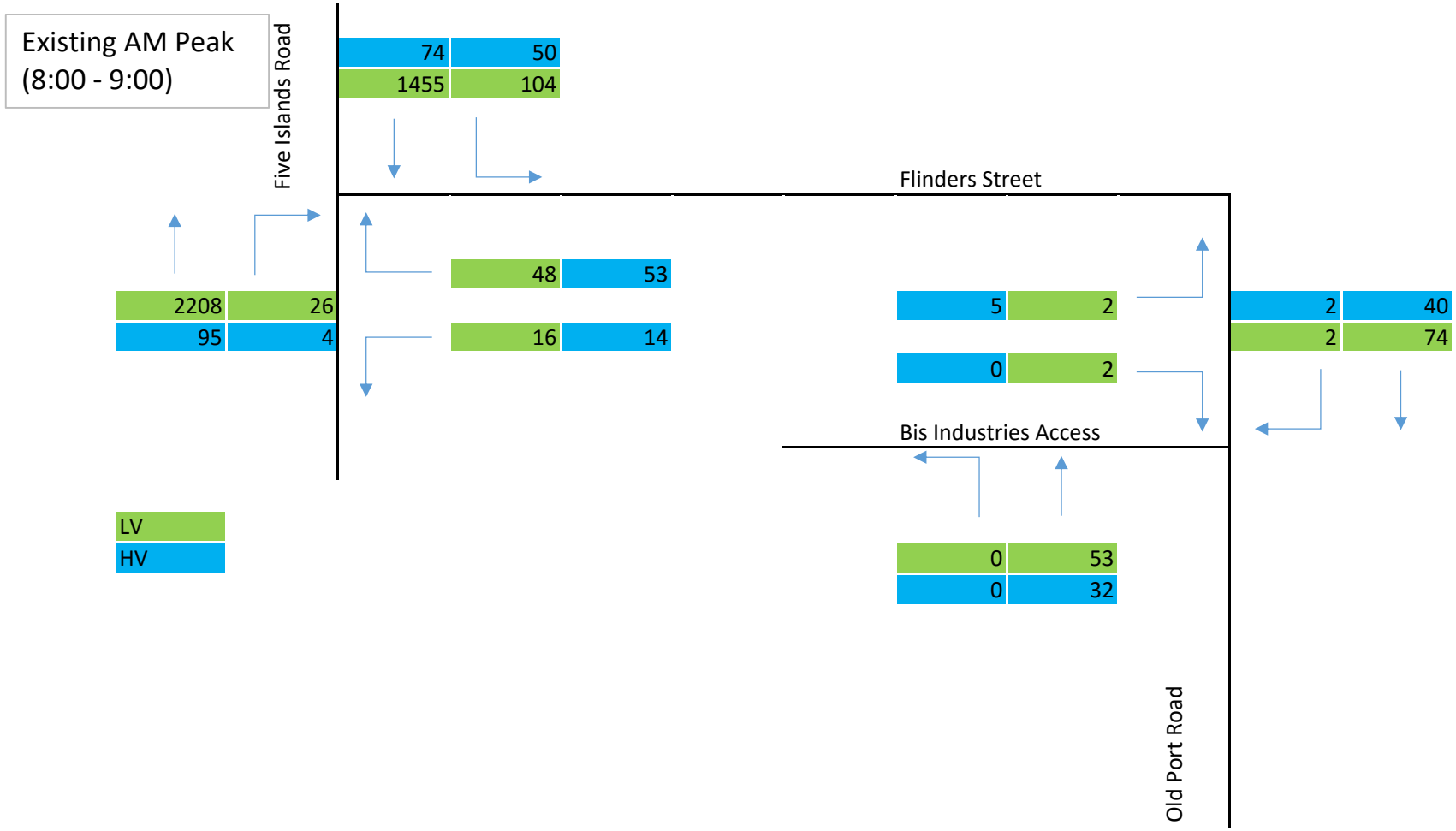
Appendix B

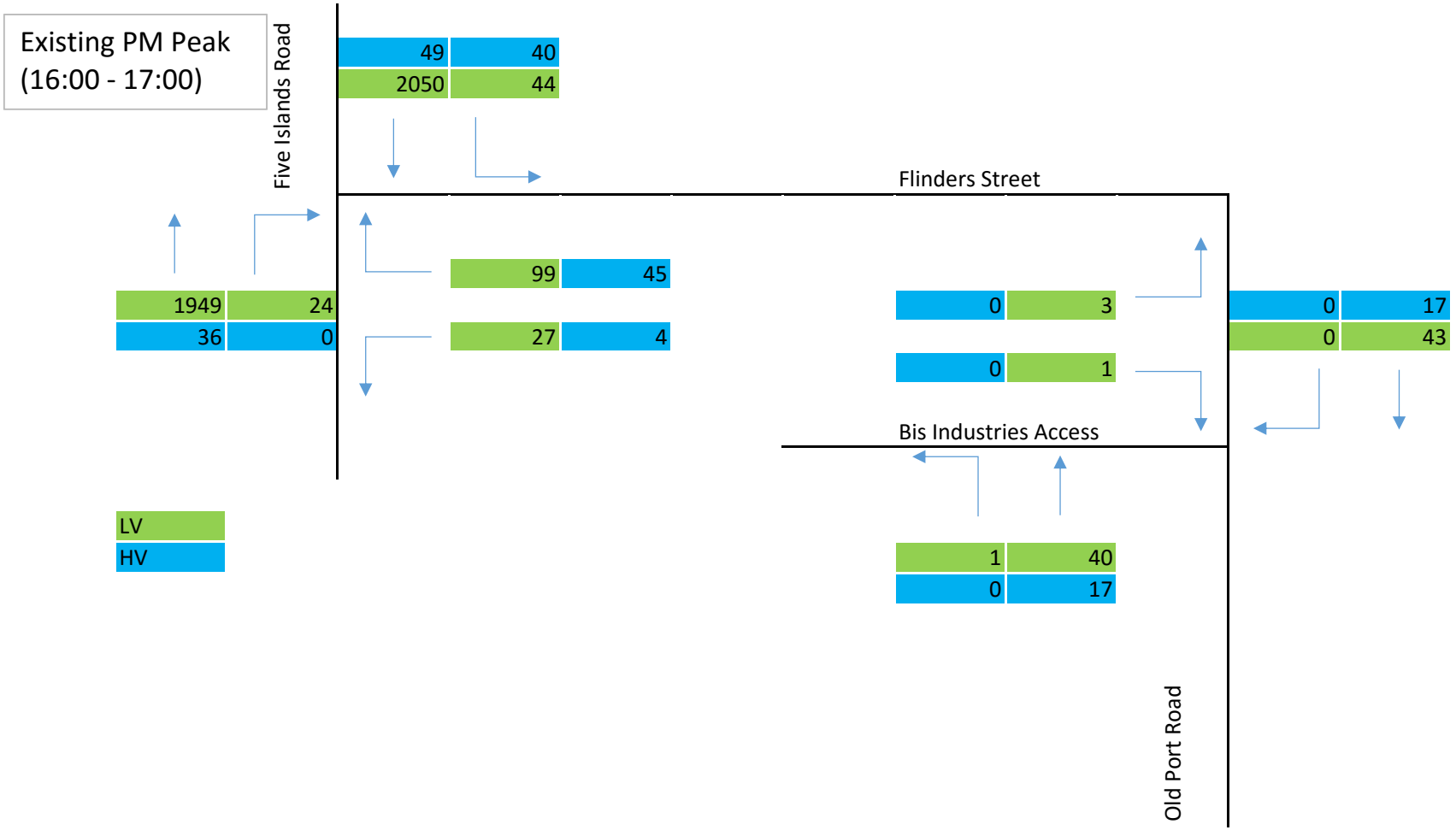
SURVEY DATA

Cardno
Shaping the Future


Existing AM Peak
(7:45 - 8:45)
Worth Street
Centenary Drive
Roberts Road
Hume Highway
6
17
125
1766
2
17
24
332
45
311
80
1673
30
48
14
4
53
499
15
161
342
49
1910
112
117
1
519
13
1
53
219
34
1418
80
121
13
LV
HV

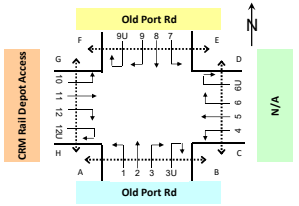

Existing PM Peak
(16:15 - 17:15)
Worth Street
Centenary Drive
Hume Highway
Roberts Road
0
19
37
1648
5
26
28
396
24
369
35
1687
16
59
13
0
21
166
11
94
375
48
2067
77
166
0
772
24
0
41
357
18
1474
69
144
18
LV
HV


Existing AM Peak
(8:00 - 9:00)
Five Islands Road
Flinders Street
Bis Industries Access
Old Port Road
74
50
1455
104
48
53
2208
26
95
4
16
14
5
2
0
2
2
40
2
74
0
53
0
32
LV
HV


Existing PM Peak
(16:00 - 17:00)
Five Islands Road
Flinders Street
Bis Industries Access
Old Port Road
49
40
2050
44
99
45
27
4
1949
24
36
0
0
3
0
1
0
17
0
43
1
40
0
17
LV
HV

Job No.	:
Client	: Cardno
Suburb	: Port Kembla
Location	: Old Port Rd / CRM Rail Depot Access
Day/Date	: Wednesday, 23 November 2016
Weather	: Fine
Description	: Classified Intersection Count
	: 15 mins Data

Classifications	**Class 1**	**Class 2**	**Class 3**	**Class 4**
	Cars	Trucks	N/A	N/A

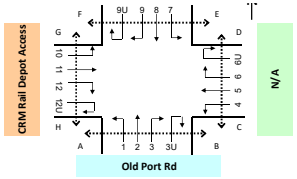


Approach	**Old Port Rd**																				**N/A**																	
Direction	**Direction 1 (Left Turn)**					**Direction 2 (Through)**					**Direction 3 (Right Turn)**					**Direction 3U (U Turn)**					**Direction 4 (Left Turn)**					**Direction 5 (Through)**					**Direction 6 (Right Turn)**					**Direction 6U (U Turn)**				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 7:15	0	0	0	0	**0**	14	7	0	0	**21**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
7:15 to 7:30	2	0	0	0	**2**	18	9	0	0	**27**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
7:30 to 7:45	0	0	0	0	**0**	12	9	0	0	**21**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
7:45 to 8:00	1	1	0	0	**2**	14	10	0	0	**24**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
8:00 to 8:15	0	0	0	0	**0**	11	7	0	0	**18**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
8:15 to 8:30	0	0	0	0	**0**	10	8	0	0	**18**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
8:30 to 8:45	0	0	0	0	**0**	14	8	0	0	**22**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
8:45 to 9:00	0	0	0	0	**0**	18	9	0	0	**27**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
AM Totals	**3**	**1**	**0**	**0**	**4**	**111**	**67**	**0**	**0**	**178**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
16:30 to 16:45	0	0	0	0	**0**	13	5	0	0	**18**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
16:45 to 17:00	0	0	0	0	**0**	10	3	0	0	**13**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
17:00 to 17:15	0	0	0	0	**0**	9	4	0	0	**13**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
17:15 to 17:30	1	0	0	0	**1**	8	5	0	0	**13**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
17:30 to 17:45	0	0	0	0	**0**	10	3	0	0	**13**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
17:45 to 18:00	0	0	0	0	**0**	9	3	0	0	**12**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
18:00 to 18:15	1	0	0	0	**1**	8	3	0	0	**11**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
18:15 to 18:30	1	0	0	0	**1**	3	4	0	0	**7**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**
PM Totals	**3**	**0**	**0**	**0**	**3**	**70**	**30**	**0**	**0**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Approach	**Old Port Rd**																				**CRM Rail Depot Access**																		**Crossing Pedestrians**								
Direction	**Direction 7 (Left Turn)**					**Direction 8 (Through)**					**Direction 9 (Right Turn)**					**Direction 9U (U Turn)**					**Direction 10 (Left Turn)**					**Direction 11 (Through)**					**Direction 12 (Right Turn)**					**Direction 12U (U Turn)**													
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	A	B	C	D	E	F	G	H	Total
7:00 to 7:15	0	0	0	0	**0**	12	2	0	0	**14**	1	0	0	0	**1**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:15 to 7:30	0	0	0	0	**0**	6	12	0	0	**18**	0	1	0	0	**1**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:30 to 7:45	0	0	0	0	**0**	16	12	0	0	**28**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:45 to 8:00	0	0	0	0	**0**	17	11	0	0	**28**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:00 to 8:15	0	0	0	0	**0**	19	9	0	0	**28**	0	0	0	0	**0**	0	0	0	0	**0**	1	2	0	0	**3**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:15 to 8:30	0	0	0	0	**0**	9	11	0	0	**20**	1	1	0	0	**2**	0	0	0	0	**0**	0	1	0	0	**1**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:30 to 8:45	0	0	0	0	**0**	19	10	0	0	**29**	0	1	0	0	**1**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:45 to 9:00	0	0	0	0	**0**	27	10	0	0	**37**	1	0	0	0	**1**	0	0	0	0	**0**	0	2	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
AM Totals	**0**	**0**	**0**	**0**	**0**	**125**	**77**	**0**	**0**	**202**	**5**	**3**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**4**	**5**	**0**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
16:30 to 16:45	0	0	0	0	**0**	7	8	0	0	**15**	0	0	0	0	**0**	0	0	0	0	**0**	2	0	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
16:45 to 17:00	0	0	0	0	**0**	13	3	0	0	**16**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:00 to 17:15	0	0	0	0	**0**	14	2	0	0	**16**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:15 to 17:30	0	0	0	0	**0**	9	4	0	0	**13**	0	0	0	0	**0**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:30 to 17:45	0	0	0	0	**0**	4	0	0	0	**4**	0	0	0	0	**0**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:45 to 18:00	0	0	0	0	**0**	9	5	0	0	**14**	0	0	0	0	**0**	0	0	0	0	**0**	2	0	0	0	**2**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
18:00 to 18:15	0	0	0	0	**0**	12	6	0	0	**18**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
18:15 to 18:30	0	0	0	0	**0**	9	8	0	0	**17**	2	0	0	0	**2**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
PM Totals	**0**	**0**	**0**	**0**	**0**	**77**	**36**	**0**	**0**	**113**	**2**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Job No. :
Client : Cardno
Suburb : Port Kembla
Location : Old Port Rd / CRM Rail Depot Access

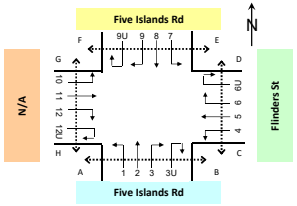
Day/Date 42697
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary



Approach	Old Port Rd																						N/A																							
Direction	Direction 1 (Left Turn)					Direction 2 (Through)					Direction 3 (Right Turn)					Direction 3U (U Turn)					Direction 4 (Left Turn)					Direction 5 (Through)					Direction 6 (Right Turn)					Direction 6U (U Turn)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	3	1	0	0	4	58	35	0	0	93	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 to 8:15	3	1	0	0	4	55	35	0	0	90	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 to 8:30	1	1	0	0	2	47	34	0	0	81	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 to 8:45	1	1	0	0	2	49	33	0	0	82	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 to 9:00	0	0	0	0	0	53	32	0	0	85	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 to 9:15	0	0	0	0	0	42	25	0	0	67	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 to 9:30	0	0	0	0	0	32	17	0	0	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 to 9:45	0	0	0	0	0	18	9	0	0	27	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AM Totals	**3**	**1**	**0**	**0**	**4**	**111**	**67**	**0**	**0**	**178**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
16:30 to 17:30	1	0	0	0	1	40	17	0	0	57	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45 to 17:45	1	0	0	0	1	37	15	0	0	52	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00 to 18:00	1	0	0	0	1	36	15	0	0	51	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15 to 18:15	2	0	0	0	2	35	14	0	0	49	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30 to 18:30	2	0	0	0	2	30	13	0	0	43	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45 to 18:45	2	0	0	0	2	20	10	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00 to 19:00	2	0	0	0	2	11	7	0	0	18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:15 to 19:15	1	0	0	0	1	3	4	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM Totals	**3**	**0**	**0**	**0**	**3**	**70**	**30**	**0**	**0**	**100**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Approach	Old Port Rd																						CRM Rail Depot Access																						Crossing Pedestrians								
Direction	Direction 7 (Left Turn)					Direction 8 (Through)					Direction 9 (Right Turn)					Direction 9U (U Turn)					Direction 10 (Left Turn)					Direction 11 (Through)					Direction 12 (Right Turn)					Direction 12U (U Turn)															
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	A	B	C	D	E	F	G	H	Total
7:00 to 8:00	0	0	0	0	0	51	37	0	0	88	3	1	0	0	4	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 to 8:15	0	0	0	0	0	58	44	0	0	102	2	1	0	0	3	0	0	0	0	0	2	2	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 to 8:30	0	0	0	0	0	61	43	0	0	104	3	1	0	0	4	0	0	0	0	0	1	3	0	0	4	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 to 8:45	0	0	0	0	0	64	41	0	0	105	2	2	0	0	4	0	0	0	0	0	2	3	0	0	5	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 to 9:00	0	0	0	0	0	74	40	0	0	114	2	2	0	0	4	0	0	0	0	0	2	5	0	0	7	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 to 9:15	0	0	0	0	0	55	31	0	0	86	2	2	0	0	4	0	0	0	0	0	1	3	0	0	4	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 to 9:30	0	0	0	0	0	46	20	0	0	66	1	1	0	0	2	0	0	0	0	0	1	2	0	0	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 to 9:45	0	0	0	0	0	27	10	0	0	37	1	0	0	0	1	0	0	0	0	0	0	2	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AM Totals	**0**	**0**	**0**	**0**	**0**	**125**	**77**	**0**	**0**	**202**	**5**	**3**	**0**	**0**	**8**	**0**	**0**	**0**	**0**	**0**	**4**	**5**	**0**	**0**	**9**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
16:30 to 17:30	0	0	0	0	0	43	17	0	0	60	0	0	0	0	0	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45 to 17:45	0	0	0	0	0	40	9	0	0	49	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00 to 18:00	0	0	0	0	0	36	11	0	0	47	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15 to 18:15	0	0	0	0	0	34	15	0	0	49	0	0	0	0	0	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30 to 18:30	0	0	0	0	0	34	19	0	0	53	2	0	0	0	2	0	0	0	0	0	4	0	0	0	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45 to 18:45	0	0	0	0	0	30	19	0	0	49	2	0	0	0	2	0	0	0	0	0	3	0	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00 to 19:00	0	0	0	0	0	21	14	0	0	35	2	0	0	0	2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:15 to 19:15	0	0	0	0	0	9	8	0	0	17	2	0	0	0	2	0	0	0	0	0	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM Totals	**0**	**0**	**0**	**0**	**0**	**77**	**36**	**0**	**0**	**113**	**2**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**7**	**0**	**0**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**1**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Job No.	:
Client	: Cardno
Suburb	: Port Kembla
Location	: Five Islands Rd / Flinders St
Day/Date	: Wednesday, 23 November 2016
Weather	: Fine
Description	: Classified Intersection Count
	: 15 mins Data



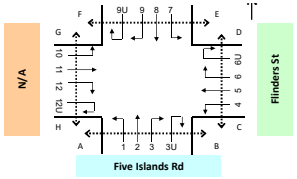
	Class 1	Class 2	Class 3	Class 4
Classifications	Cars	Trucks	N/A	N/A

Approach	Five Islands Rd																					Flinders St										
Direction	Direction 1 (Left Turn)					Direction 2 (Through)					Direction 3 (Right Turn)					Direction 3U (U Turn)					Direction 4 (Left Turn)					Direction 5 (Through)					Direction 6 (Right Turn)					Direction 6U (U Turn)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 7:15	0	0	0	0	**0**	290	19	0	0	**309**	16	0	0	0	**16**	0	0	0	0	**0**	3	1	0	0	**4**	0	0	0	0	**0**	8	12	0	0	**20**	0	0	0	0	**0**
7:15 to 7:30	0	0	0	0	**0**	379	13	0	0	**392**	17	2	0	0	**19**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	12	16	0	0	**28**	0	0	0	0	**0**
7:30 to 7:45	0	0	0	0	**0**	478	20	0	0	**498**	6	1	0	0	**7**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	12	10	0	0	**22**	0	0	0	0	**0**
7:45 to 8:00	0	0	0	0	**0**	496	20	0	0	**516**	8	1	0	0	**9**	0	0	0	0	**0**	3	0	0	0	**3**	0	0	0	0	**0**	10	13	0	0	**23**	0	0	0	0	**0**
8:00 to 8:15	0	0	0	0	**0**	551	22	0	0	**573**	4	1	0	0	**5**	0	0	0	0	**0**	1	1	0	0	**2**	0	0	0	0	**0**	11	13	0	0	**24**	0	0	0	0	**0**
8:15 to 8:30	0	0	0	0	**0**	592	21	0	0	**613**	10	1	0	0	**11**	0	0	0	0	**0**	5	3	0	0	**8**	0	0	0	0	**0**	9	18	0	0	**27**	0	0	0	0	**0**
8:30 to 8:45	0	0	0	0	**0**	541	27	0	0	**568**	8	2	0	0	**10**	0	0	0	0	**0**	5	7	0	0	**12**	0	0	0	0	**0**	20	13	0	0	**33**	0	0	0	0	**0**
8:45 to 9:00	0	0	0	0	**0**	524	25	0	0	**549**	4	0	0	0	**4**	0	0	0	0	**0**	5	3	0	0	**8**	0	0	0	0	**0**	8	9	0	0	**17**	0	0	0	0	**0**
AM Totals	**0**	**0**	**0**	**0**	**0**	**3,851**	**167**	**0**	**0**	**4,018**	**73**	**8**	**0**	**0**	**81**	**0**	**0**	**0**	**0**	**0**	**23**	**15**	**0**	**0**	**38**	**0**	**0**	**0**	**0**	**0**	**90**	**104**	**0**	**0**	**194**	**0**	**0**	**0**	**0**	**0**
16:30 to 16:45	0	0	0	0	**0**	525	11	0	0	**536**	6	0	0	0	**6**	0	0	0	0	**0**	6	0	0	0	**6**	0	0	0	0	**0**	35	16	0	0	**51**	0	0	0	0	**0**
16:45 to 17:00	0	0	0	0	**0**	436	9	0	0	**445**	1	0	0	0	**1**	0	0	0	0	**0**	3	3	0	0	**6**	0	0	0	0	**0**	25	7	0	0	**32**	0	0	0	0	**0**
17:00 to 17:15	0	0	0	0	**0**	538	9	0	0	**547**	7	0	0	0	**7**	0	0	0	0	**0**	13	1	0	0	**14**	0	0	0	0	**0**	29	11	0	0	**40**	0	0	0	0	**0**
17:15 to 17:30	0	0	0	0	**0**	450	7	0	0	**457**	10	0	0	0	**10**	0	0	0	0	**0**	5	0	0	0	**5**	0	0	0	0	**0**	10	11	0	0	**21**	0	0	0	0	**0**
17:30 to 17:45	0	0	0	0	**0**	414	5	0	0	**419**	5	0	0	0	**5**	0	0	0	0	**0**	6	0	0	0	**6**	0	0	0	0	**0**	19	6	0	0	**25**	0	0	0	0	**0**
17:45 to 18:00	0	0	0	0	**0**	359	6	0	0	**365**	0	0	0	0	**0**	0	0	0	0	**0**	8	0	0	0	**8**	0	0	0	0	**0**	23	7	0	0	**30**	0	0	0	0	**0**
18:00 to 18:15	0	0	0	0	**0**	297	2	0	0	**299**	2	0	0	0	**2**	0	0	0	0	**0**	7	0	0	0	**7**	0	0	0	0	**0**	22	5	0	0	**27**	0	0	0	0	**0**
18:15 to 18:30	0	0	0	0	**0**	228	8	0	0	**236**	4	1	0	0	**5**	0	0	0	0	**0**	2	0	0	0	**2**	0	0	0	0	**0**	8	8	0	0	**16**	0	0	0	0	**0**
PM Totals	**0**	**0**	**0**	**0**	**0**	**3,247**	**57**	**0**	**0**	**3,304**	**35**	**1**	**0**	**0**	**36**	**0**	**0**	**0**	**0**	**0**	**50**	**4**	**0**	**0**	**54**	**0**	**0**	**0**	**0**	**0**	**171**	**71**	**0**	**0**	**242**	**0**	**0**	**0**	**0**	**0**

Approach	Five Islands Rd																					N/A											Crossing Pedestrians								
Direction	Direction 7 (Left Turn)					Direction 8 (Through)					Direction 9 (Right Turn)					Direction 9U (U Turn)					Direction 10 (Left Turn)					Direction 11 (Through)					Direction 12 (Right Turn)					Direction 12U (U Turn)													
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	A	B	C	D	E	F	G	H	Total
7:00 to 7:15	40	15	0	0	**55**	199	20	0	0	**219**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:15 to 7:30	46	17	0	0	**63**	174	18	0	0	**192**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:30 to 7:45	33	13	0	0	**46**	284	21	0	0	**305**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:45 to 8:00	28	12	0	0	**40**	309	9	0	0	**318**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:00 to 8:15	25	13	0	0	**38**	348	23	0	0	**371**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:15 to 8:30	20	14	0	0	**34**	361	24	0	0	**385**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:30 to 8:45	33	14	0	0	**47**	382	14	0	0	**396**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:45 to 9:00	26	9	0	0	**35**	364	13	0	0	**377**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
AM Totals	**251**	**107**	**0**	**0**	**358**	**2,421**	**142**	**0**	**0**	**2,563**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
16:30 to 16:45	10	14	0	0	**24**	478	12	0	0	**490**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
16:45 to 17:00	10	10	0	0	**20**	497	18	0	0	**515**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:00 to 17:15	13	6	0	0	**19**	488	15	0	0	**503**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:15 to 17:30	11	10	0	0	**21**	587	4	0	0	**591**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:30 to 17:45	12	10	0	0	**22**	497	11	0	0	**508**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:45 to 18:00	15	11	0	0	**26**	429	9	0	0	**438**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
18:00 to 18:15	10	8	0	0	**18**	350	2	0	0	**352**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
18:15 to 18:30	12	6	0	0	**18**	304	5	0	0	**309**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
PM Totals	**93**	**75**	**0**	**0**	**168**	**3,630**	**76**	**0**	**0**	**3,706**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Job No. :
Client : Cardno
Suburb : Port Kembla
Location : Five Islands Rd / Flinders St

Day/Date 42697
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary

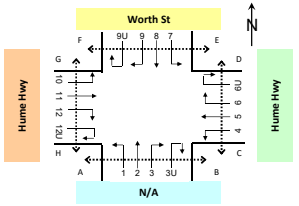


Approach	Five Islands Rd																				Flinders St																			
Direction	Direction 1 (Left Turn)					Direction 2 (Through)					Direction 3 (Right Turn)					Direction 3U (U Turn)					Direction 4 (Left Turn)					Direction 5 (Through)					Direction 6 (Right Turn)					Direction 6U (U Turn)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	0	0	0	0	0	1,643	72	0	0	1,715	47	4	0	0	51	0	0	0	0	0	7	1	0	0	8	0	0	0	0	0	42	51	0	0	93	0	0	0	0	0
7:15 to 8:15	0	0	0	0	0	1,904	75	0	0	1,979	35	5	0	0	40	0	0	0	0	0	5	1	0	0	6	0	0	0	0	0	45	52	0	0	97	0	0	0	0	0
7:30 to 8:30	0	0	0	0	0	2,117	83	0	0	2,200	28	4	0	0	32	0	0	0	0	0	10	4	0	0	14	0	0	0	0	0	42	54	0	0	96	0	0	0	0	0
7:45 to 8:45	0	0	0	0	0	2,180	90	0	0	2,270	30	5	0	0	35	0	0	0	0	0	14	11	0	0	25	0	0	0	0	0	50	57	0	0	107	0	0	0	0	0
8:00 to 9:00	0	0	0	0	0	2,208	95	0	0	2,303	26	4	0	0	30	0	0	0	0	0	16	14	0	0	30	0	0	0	0	0	48	53	0	0	101	0	0	0	0	0
8:15 to 9:15	0	0	0	0	0	1,657	73	0	0	1,730	22	3	0	0	25	0	0	0	0	0	15	13	0	0	28	0	0	0	0	0	37	40	0	0	77	0	0	0	0	0
8:30 to 9:30	0	0	0	0	0	1,065	52	0	0	1,117	12	2	0	0	14	0	0	0	0	0	10	10	0	0	20	0	0	0	0	0	28	22	0	0	50	0	0	0	0	0
8:45 to 9:45	0	0	0	0	0	524	25	0	0	549	4	0	0	0	4	0	0	0	0	0	5	3	0	0	8	0	0	0	0	0	8	9	0	0	17	0	0	0	0	0
AM Totals	**0**	**0**	**0**	**0**	**0**	**3,851**	**167**	**0**	**0**	**4,018**	**73**	**8**	**0**	**0**	**81**	**0**	**0**	**0**	**0**	**0**	**23**	**15**	**0**	**0**	**38**	**0**	**0**	**0**	**0**	**0**	**90**	**104**	**0**	**0**	**194**	**0**	**0**	**0**	**0**	**0**
16:30 to 17:30	0	0	0	0	0	1,949	36	0	0	1,985	24	0	0	0	24	0	0	0	0	0	27	4	0	0	31	0	0	0	0	0	99	45	0	0	144	0	0	0	0	0
16:45 to 17:45	0	0	0	0	0	1,838	30	0	0	1,868	23	0	0	0	23	0	0	0	0	0	27	4	0	0	31	0	0	0	0	0	83	35	0	0	118	0	0	0	0	0
17:00 to 18:00	0	0	0	0	0	1,761	27	0	0	1,788	22	0	0	0	22	0	0	0	0	0	32	1	0	0	33	0	0	0	0	0	81	35	0	0	116	0	0	0	0	0
17:15 to 18:15	0	0	0	0	0	1,520	20	0	0	1,540	17	0	0	0	17	0	0	0	0	0	26	0	0	0	26	0	0	0	0	0	74	29	0	0	103	0	0	0	0	0
17:30 to 18:30	0	0	0	0	0	1,298	21	0	0	1,319	11	1	0	0	12	0	0	0	0	0	23	0	0	0	23	0	0	0	0	0	72	26	0	0	98	0	0	0	0	0
17:45 to 18:45	0	0	0	0	0	884	16	0	0	900	6	1	0	0	7	0	0	0	0	0	17	0	0	0	17	0	0	0	0	0	53	20	0	0	73	0	0	0	0	0
18:00 to 19:00	0	0	0	0	0	525	10	0	0	535	6	1	0	0	7	0	0	0	0	0	9	0	0	0	9	0	0	0	0	0	30	13	0	0	43	0	0	0	0	0
18:15 to 19:15	0	0	0	0	0	228	8	0	0	236	4	1	0	0	5	0	0	0	0	0	2	0	0	0	2	0	0	0	0	0	8	8	0	0	16	0	0	0	0	0
PM Totals	**0**	**0**	**0**	**0**	**0**	**3,247**	**57**	**0**	**0**	**3,304**	**35**	**1**	**0**	**0**	**36**	**0**	**0**	**0**	**0**	**0**	**50**	**4**	**0**	**0**	**54**	**0**	**0**	**0**	**0**	**0**	**171**	**71**	**0**	**0**	**242**	**0**	**0**	**0**	**0**	**0**

Approach	Five Islands Rd																				N/A																			
Direction	Direction 7 (Left Turn)					Direction 8 (Through)					Direction 9 (Right Turn)					Direction 9U (U Turn)					Direction 10 (Left Turn)					Direction 11 (Through)					Direction 12 (Right Turn)					Direction 12U (U Turn)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	147	57	0	0	204	966	68	0	0	1,034	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:15 to 8:15	132	55	0	0	187	1,115	71	0	0	1,186	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:30 to 8:30	106	52	0	0	158	1,302	77	0	0	1,379	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
7:45 to 8:45	106	53	0	0	159	1,400	70	0	0	1,470	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:00 to 9:00	104	50	0	0	154	1,455	74	0	0	1,529	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:15 to 9:15	79	37	0	0	116	1,107	51	0	0	1,158	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:30 to 9:30	59	23	0	0	82	746	27	0	0	773	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 to 9:45	26	9	0	0	35	364	13	0	0	377	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AM Totals	**251**	**107**	**0**	**0**	**358**	**2,421**	**142**	**0**	**0**	**2,563**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
16:30 to 17:30	44	40	0	0	84	2,050	49	0	0	2,099	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16:45 to 17:45	46	36	0	0	82	2,069	48	0	0	2,117	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:00 to 18:00	51	37	0	0	88	2,001	39	0	0	2,040	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:15 to 18:15	48	39	0	0	87	1,863	26	0	0	1,889	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:30 to 18:30	49	35	0	0	84	1,580	27	0	0	1,607	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
17:45 to 18:45	37	25	0	0	62	1,083	16	0	0	1,099	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:00 to 19:00	22	14	0	0	36	654	7	0	0	661	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18:15 to 19:15	12	6	0	0	18	304	5	0	0	309	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
PM Totals	**93**	**75**	**0**	**0**	**168**	**3,630**	**76**	**0**	**0**	**3,706**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

Approach	Crossing Pedestrians								
Direction									
Time Period	A	B	C	D	E	F	G	H	Total
7:00 to 8:00	0	0	0	0	0	0	0	0	0
7:15 to 8:15	0	0	0	0	0	0	0	0	0
7:30 to 8:30	0	0	0	0	0	0	0	0	0
7:45 to 8:45	0	0	0	0	0	0	0	0	0
8:00 to 9:00	0	0	0	0	0	0	0	0	0
8:15 to 9:15	0	0	0	0	0	0	0	0	0
8:30 to 9:30	0	0	0	0	0	0	0	0	0
8:45 to 9:45	0	0	0	0	0	0	0	0	0
AM Totals	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**
16:30 to 17:30	0	0	0	0	0	0	0	0	0
16:45 to 17:45	0	0	0	0	0	0	0	0	0
17:00 to 18:00	0	0	0	0	0	0	0	0	0
17:15 to 18:15	0	0	0	0	0	0	0	0	0
17:30 to 18:30	0	0	0	0	0	0	0	0	0
17:45 to 18:45	0	0	0	0	0	0	0	0	0
18:00 to 19:00	0	0	0	0	0	0	0	0	0
18:15 to 19:15	0	0	0	0	0	0	0	0	0
PM Totals	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**

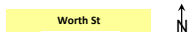
Job No.	:
Client	: Cardno
Suburb	: Homebush West
Location	: Worth St / Hume Hwy
Day/Date	: Wednesday, 23 November 2016
Weather	: Fine
Description	: Classified Intersection Count
	: 15 mins Data



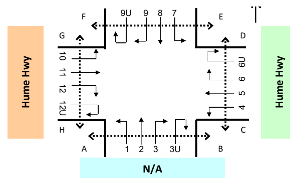
Classifications	**Class 1**	**Class 2**	**Class 3**	**Class 4**
	Cars	Trucks	N/A	N/A

Approach	**N/A**																					**Hume Hwy**										
Direction	**Direction 1 (Left Turn)**					**Direction 2 (Through)**					**Direction 3 (Right Turn)**					**Direction 3U (U Turn)**					**Direction 4 (Left Turn)**					**Direction 5 (Through)**					**Direction 6 (Right Turn)**					**Direction 6U (U Turn)**				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 7:15	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	339	26	0	0	**365**	43	16	0	0	**59**	0	0	0	0	**0**
7:15 to 7:30	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	392	22	0	0	**414**	73	12	0	0	**85**	0	0	0	0	**0**
7:30 to 7:45	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	453	25	0	0	**478**	99	8	0	0	**107**	0	0	0	0	**0**
7:45 to 8:00	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	433	28	0	0	**461**	94	9	0	0	**103**	0	0	0	0	**0**
8:00 to 8:15	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	485	27	0	0	**512**	77	15	0	0	**92**	0	0	0	0	**0**
8:15 to 8:30	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	503	24	0	0	**527**	76	14	0	0	**90**	0	0	0	0	**0**
8:30 to 8:45	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	489	33	0	0	**522**	95	11	0	0	**106**	0	0	0	0	**0**
8:45 to 9:00	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	396	32	0	0	**428**	88	14	0	0	**102**	0	0	0	0	**0**
AM Totals	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**3,490**	**217**	**0**	**0**	**3,707**	**645**	**99**	**0**	**0**	**744**	**0**	**0**	**0**	**0**	**0**
16:30 to 16:45	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	550	26	0	0	**576**	90	12	0	0	**102**	0	0	0	0	**0**
16:45 to 17:00	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	517	27	0	0	**544**	94	13	0	0	**107**	0	0	0	0	**0**
17:00 to 17:15	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	544	14	0	0	**558**	95	12	0	0	**107**	0	0	0	0	**0**
17:15 to 17:30	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	462	21	0	0	**483**	90	11	0	0	**101**	0	0	0	0	**0**
17:30 to 17:45	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	544	15	0	0	**559**	96	12	0	0	**108**	0	0	0	0	**0**
17:45 to 18:00	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	452	16	0	0	**468**	92	11	0	0	**103**	0	0	0	0	**0**
18:00 to 18:15	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	513	23	0	0	**536**	75	4	0	0	**79**	0	0	0	0	**0**
18:15 to 18:30	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	**0**	566	12	0	0	**578**	45	12	0	0	**57**	0	0	0	0	**0**
PM Totals	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4,148**	**154**	**0**	**0**	**4,302**	**677**	**87**	**0**	**0**	**764**	**0**	**0**	**0**	**0**	**0**

Approach	**Worth St**																					**Hume Hwy**											**Crossing Pedestrians**								
Direction	**Direction 7 (Left Turn)**					**Direction 8 (Through)**					**Direction 9 (Right Turn)**					**Direction 9U (U Turn)**					**Direction 10 (Left Turn)**					**Direction 11 (Through)**					**Direction 12 (Right Turn)**					**Direction 12U (U Turn)**													
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	A	B	C	D	E	F	G	H	Total
7:00 to 7:15	85	6	0	0	**91**	0	0	0	0	**0**	3	1	0	0	**4**	0	0	0	0	**0**	3	0	0	0	**3**	494	24	0	0	**518**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:15 to 7:30	64	5	0	0	**69**	0	0	0	0	**0**	1	1	0	0	**2**	0	0	0	0	**0**	2	2	0	0	**4**	489	25	0	0	**514**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:30 to 7:45	79	7	0	0	**86**	0	0	0	0	**0**	4	2	0	0	**6**	0	0	0	0	**0**	3	3	0	0	**6**	417	30	0	0	**447**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:45 to 8:00	65	7	0	0	**72**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	7	1	0	0	**8**	488	26	0	0	**514**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:00 to 8:15	98	7	0	0	**105**	0	0	0	0	**0**	6	0	0	0	**6**	0	0	0	0	**0**	3	1	0	0	**4**	464	33	0	0	**497**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	2	0	0	0	0	0	**2**
8:15 to 8:30	88	6	0	0	**94**	0	0	0	0	**0**	1	0	0	0	**1**	0	0	0	0	**0**	1	1	0	0	**2**	389	34	0	0	**423**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:30 to 8:45	81	4	0	0	**85**	0	0	0	0	**0**	9	2	0	0	**11**	0	0	0	0	**0**	6	3	0	0	**9**	425	32	0	0	**457**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:45 to 9:00	78	8	0	0	**86**	0	0	0	0	**0**	5	2	0	0	**7**	0	0	0	0	**0**	2	2	0	0	**4**	333	35	0	0	**368**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
AM Totals	**638**	**50**	**0**	**0**	**688**	**0**	**0**	**0**	**0**	**0**	**30**	**8**	**0**	**0**	**38**	**0**	**0**	**0**	**0**	**0**	**27**	**13**	**0**	**0**	**40**	**3,499**	**239**	**0**	**0**	**3,738**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2**	**0**	**0**	**0**	**0**	**0**	**2**
16:30 to 16:45	85	3	0	0	**88**	0	0	0	0	**0**	9	2	0	0	**11**	0	0	0	0	**0**	4	1	0	0	**5**	342	11	0	0	**353**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	1	0	0	0	**1**
16:45 to 17:00	75	9	0	0	**84**	0	0	0	0	**0**	8	2	0	0	**10**	0	0	0	0	**0**	4	0	0	0	**4**	368	13	0	0	**381**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:00 to 17:15	107	6	0	0	**113**	0	0	0	0	**0**	6	1	0	0	**7**	0	0	0	0	**0**	6	0	0	0	**6**	413	10	0	0	**423**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:15 to 17:30	117	9	0	0	**126**	0	0	0	0	**0**	4	1	0	0	**5**	0	0	0	0	**0**	3	0	0	0	**3**	415	5	0	0	**420**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:30 to 17:45	97	4	0	0	**101**	0	0	0	0	**0**	8	1	0	0	**9**	0	0	0	0	**0**	6	0	0	0	**6**	452	9	0	0	**461**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	1	0	0	0	0	**1**
17:45 to 18:00	68	5	0	0	**73**	0	0	0	0	**0**	8	0	0	0	**8**	0	0	0	0	**0**	2	0	0	0	**2**	418	8	0	0	**426**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
18:00 to 18:15	56	8	0	0	**64**	0	0	0	0	**0**	4	2	0	0	**6**	0	0	0	0	**0**	1	0	0	0	**1**	401	7	0	0	**408**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
18:15 to 18:30	45	4	0	0	**49**	0	0	0	0	**0**	3	1	0	0	**4**	0	0	0	0	**0**	5	0	0	0	**5**	341	4	0	0	**345**	0	0	0	0	**0**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
PM Totals	**650**	**48**	**0**	**0**	**698**	**0**	**0**	**0**	**0**	**0**	**50**	**10**	**0**	**0**	**60**	**0**	**0**	**0**	**0**	**0**	**31**	**1**	**0**	**0**	**32**	**3,150**	**67**	**0**	**0**	**3,217**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**1**	**1**	**0**	**0**	**0**	**2**



Job No.	:
Client	: Cardno
Suburb	: Homebush West
Location	: Worth St / Hume Hwy
Day/Date	42697
Weather	: Fine
Description	: Classified Intersection Count
	: Hourly Summary



Approach	N/A									
Direction	Direction 1 (Left Turn)					Direction 2 (Through)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	0	0	0	0	0	0	0	0	0	0
7:15 to 8:15	0	0	0	0	0	0	0	0	0	0
7:30 to 8:30	0	0	0	0	0	0	0	0	0	0
7:45 to 8:45	0	0	0	0	0	0	0	0	0	0
8:00 to 9:00	0	0	0	0	0	0	0	0	0	0
8:15 to 9:15	0	0	0	0	0	0	0	0	0	0
8:30 to 9:30	0	0	0	0	0	0	0	0	0	0
8:45 to 9:45	0	0	0	0	0	0	0	0	0	0
AM Totals	0	0	0	0	0	0	0	0	0	0
16:30 to 17:30	0	0	0	0	0	0	0	0	0	0
16:45 to 17:45	0	0	0	0	0	0	0	0	0	0
17:00 to 18:00	0	0	0	0	0	0	0	0	0	0
17:15 to 18:15	0	0	0	0	0	0	0	0	0	0
17:30 to 18:30	0	0	0	0	0	0	0	0	0	0
17:45 to 18:45	0	0	0	0	0	0	0	0	0	0
18:00 to 19:00	0	0	0	0	0	0	0	0	0	0
18:15 to 19:15	0	0	0	0	0	0	0	0	0	0
PM Totals	0	0	0	0	0	0	0	0	0	0

Approach	N/A									
Direction	Direction 3 (Right Turn)					Direction 3U (U Turn)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	0	0	0	0	0	0	0	0	0	0
7:15 to 8:15	0	0	0	0	0	0	0	0	0	0
7:30 to 8:30	0	0	0	0	0	0	0	0	0	0
7:45 to 8:45	0	0	0	0	0	0	0	0	0	0
8:00 to 9:00	0	0	0	0	0	0	0	0	0	0
8:15 to 9:15	0	0	0	0	0	0	0	0	0	0
8:30 to 9:30	0	0	0	0	0	0	0	0	0	0
8:45 to 9:45	0	0	0	0	0	0	0	0	0	0
AM Totals	0	0	0	0	0	0	0	0	0	0
16:30 to 17:30	0	0	0	0	0	0	0	0	0	0
16:45 to 17:45	0	0	0	0	0	0	0	0	0	0
17:00 to 18:00	0	0	0	0	0	0	0	0	0	0
17:15 to 18:15	0	0	0	0	0	0	0	0	0	0
17:30 to 18:30	0	0	0	0	0	0	0	0	0	0
17:45 to 18:45	0	0	0	0	0	0	0	0	0	0
18:00 to 19:00	0	0	0	0	0	0	0	0	0	0
18:15 to 19:15	0	0	0	0	0	0	0	0	0	0
PM Totals	0	0	0	0	0	0	0	0	0	0

Approach	Hume Hwy									
Direction	Direction 4 (Left Turn)					Direction 5 (Through)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	0	0	0	0	0	1,617	101	0	0	1,718
7:15 to 8:15	0	0	0	0	0	1,763	102	0	0	1,865
7:30 to 8:30	0	0	0	0	0	1,874	104	0	0	1,978
7:45 to 8:45	0	0	0	0	0	1,910	112	0	0	2,022
8:00 to 9:00	0	0	0	0	0	1,873	116	0	0	1,989
8:15 to 9:15	0	0	0	0	0	1,388	89	0	0	1,477
8:30 to 9:30	0	0	0	0	0	885	65	0	0	950
8:45 to 9:45	0	0	0	0	0	396	32	0	0	428
AM Totals	0	0	0	0	0	3,490	217	0	0	3,707
16:30 to 17:30	0	0	0	0	0	2,073	88	0	0	2,161
16:45 to 17:45	0	0	0	0	0	2,067	77	0	0	2,144
17:00 to 18:00	0	0	0	0	0	2,002	66	0	0	2,068
17:15 to 18:15	0	0	0	0	0	1,971	75	0	0	2,046
17:30 to 18:30	0	0	0	0	0	2,075	66	0	0	2,141
17:45 to 18:45	0	0	0	0	0	1,531	51	0	0	1,582
18:00 to 19:00	0	0	0	0	0	1,079	35	0	0	1,114
18:15 to 19:15	0	0	0	0	0	566	12	0	0	578
PM Totals	0	0	0	0	0	4,148	154	0	0	4,302

Approach	Hume Hwy									
Direction	Direction 6 (Right Turn)					Direction 6U (U Turn)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	309	45	0	0	354	0	0	0	0	0
7:15 to 8:15	343	44	0	0	387	0	0	0	0	0
7:30 to 8:30	346	46	0	0	392	0	0	0	0	0
7:45 to 8:45	342	49	0	0	391	0	0	0	0	0
8:00 to 9:00	336	54	0	0	390	0	0	0	0	0
8:15 to 9:15	259	39	0	0	298	0	0	0	0	0
8:30 to 9:30	183	25	0	0	208	0	0	0	0	0
8:45 to 9:45	88	14	0	0	102	0	0	0	0	0
AM Totals	645	99	0	0	744	0	0	0	0	0
16:30 to 17:30	369	48	0	0	417	0	0	0	0	0
16:45 to 17:45	375	48	0	0	423	0	0	0	0	0
17:00 to 18:00	373	46	0	0	419	0	0	0	0	0
17:15 to 18:15	353	38	0	0	391	0	0	0	0	0
17:30 to 18:30	308	39	0	0	347	0	0	0	0	0
17:45 to 18:45	212	27	0	0	239	0	0	0	0	0
18:00 to 19:00	120	16	0	0	136	0	0	0	0	0
18:15 to 19:15	45	12	0	0	57	0	0	0	0	0
PM Totals	677	87	0	0	764	0	0	0	0	0

Approach	Worth St									
Direction	Direction 7 (Left Turn)					Direction 8 (Through)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	293	25	0	0	318	0	0	0	0	0
7:15 to 8:15	306	26	0	0	332	0	0	0	0	0
7:30 to 8:30	330	27	0	0	357	0	0	0	0	0
7:45 to 8:45	332	24	0	0	356	0	0	0	0	0
8:00 to 9:00	345	25	0	0	370	0	0	0	0	0
8:15 to 9:15	247	18	0	0	265	0	0	0	0	0
8:30 to 9:30	159	12	0	0	171	0	0	0	0	0
8:45 to 9:45	78	8	0	0	86	0	0	0	0	0
AM Totals	638	50	0	0	688	0	0	0	0	0
16:30 to 17:30	384	27	0	0	411	0	0	0	0	0
16:45 to 17:45	396	28	0	0	424	0	0	0	0	0
17:00 to 18:00	389	24	0	0	413	0	0	0	0	0
17:15 to 18:15	338	26	0	0	364	0	0	0	0	0
17:30 to 18:30	266	21	0	0	287	0	0	0	0	0
17:45 to 18:45	169	17	0	0	186	0	0	0	0	0
18:00 to 19:00	101	12	0	0	113	0	0	0	0	0
18:15 to 19:15	45	4	0	0	49	0	0	0	0	0
PM Totals	650	48	0	0	698	0	0	0	0	0

Approach	Worth St									
Direction	Direction 9 (Right Turn)					Direction 9U (U Turn)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	9	4	0	0	13	0	0	0	0	0
7:15 to 8:15	12	3	0	0	15	0	0	0	0	0
7:30 to 8:30	12	2	0	0	14	0	0	0	0	0
7:45 to 8:45	17	2	0	0	19	0	0	0	0	0
8:00 to 9:00	21	4	0	0	25	0	0	0	0	0
8:15 to 9:15	15	4	0	0	19	0	0	0	0	0
8:30 to 9:30	14	4	0	0	18	0	0	0	0	0
8:45 to 9:45	5	2	0	0	7	0	0	0	0	0
AM Totals	30	8	0	0	38	0	0	0	0	0
16:30 to 17:30	27	6	0	0	33	0	0	0	0	0
16:45 to 17:45	26	5	0	0	31	0	0	0	0	0
17:00 to 18:00	26	3	0	0	29	0	0	0	0	0
17:15 to 18:15	24	4	0	0	28	0	0	0	0	0
17:30 to 18:30	23	4	0	0	27	0	0	0	0	0
17:45 to 18:45	15	3	0	0	18	0	0	0	0	0
18:00 to 19:00	7	3	0	0	10	0	0	0	0	0
18:15 to 19:15	3	1	0	0	4	0	0	0	0	0
PM Totals	50	10	0	0	60	0	0	0	0	0

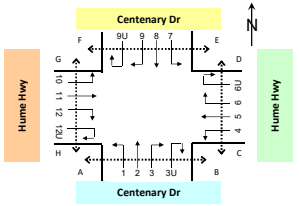
Approach	Hume Hwy									
Direction	Direction 10 (Left Turn)					Direction 11 (Through)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	15	6	0	0	21	1,888	105	0	0	1,993
7:15 to 8:15	15	7	0	0	22	1,858	114	0	0	1,972
7:30 to 8:30	14	6	0	0	20	1,758	123	0	0	1,881
7:45 to 8:45	17	6	0	0	23	1,766	125	0	0	1,891
8:00 to 9:00	12	7	0	0	19	1,611	134	0	0	1,745
8:15 to 9:15	9	6	0	0	15	1,147	101	0	0	1,248
8:30 to 9:30	8	5	0	0	13	758	67	0	0	825
8:45 to 9:45	2	2	0	0	4	333	35	0	0	368
AM Totals	27	13	0	0	40	3,499	239	0	0	3,738
16:30 to 17:30	17	1	0	0	18	1,538	39	0	0	1,577
16:45 to 17:45	19	0	0	0	19	1,648	37	0	0	1,685
17:00 to 18:00	17	0	0	0	17	1,698	32	0	0	1,730
17:15 to 18:15	12	0	0	0	12	1,686	29	0	0	1,715
17:30 to 18:30	14	0	0	0	14	1,612	28	0	0	1,640
17:45 to 18:45	8	0	0	0	8	1,160	19	0	0	1,179
18:00 to 19:00	6	0	0	0	6	742	11	0	0	753
18:15 to 19:15	5	0	0	0	5	341	4	0	0	345
PM Totals	31	1	0	0	32	3,150	67	0	0	3,217

Approach	Hume Hwy									
Direction	Direction 12 (Right Turn)					Direction 12U (U Turn)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	0	0	0	0	0	0	0	0	0	0
7:15 to 8:15	0	0	0	0	0	0	0	0	0	0
7:30 to 8:30	0	0	0	0	0	0	0	0	0	0
7:45 to 8:45	0	0	0	0	0	0	0	0	0	0
8:00 to 9:00	0	0	0	0	0	0	0	0	0	0
8:15 to 9:15	0	0	0	0	0	0	0	0	0	0
8:30 to 9:30	0	0	0	0	0	0	0	0	0	0
8:45 to 9:45	0	0	0	0	0	0	0	0	0	0
AM Totals	0	0	0	0	0	0	0	0	0	0
16:30 to 17:30	0	0	0	0	0	0	0	0	0	0
16:45 to 17:45	0	0	0	0	0	0	0	0	0	0
17:00 to 18:00	0	0	0	0	0	0	0	0	0	0
17:15 to 18:15	0	0	0	0	0	0	0	0	0	0
17:30 to 18:30	0	0	0	0	0	0	0	0	0	0
17:45 to 18:45	0	0	0	0	0	0	0	0	0	0
18:00 to 19:00	0	0	0	0	0	0	0	0	0	0
18:15 to 19:15	0	0	0	0	0	0	0	0	0	0
PM Totals	0	0	0	0	0	0	0	0	0	0

	Crossing Pedestrians								
Time Period	A	B	C	D	E	F	G	H	Total
7:00 to 8:00	0	0	0	0	0	0	0	0	0
7:15 to 8:15	0	0	2	0	0	0	0	0	2
7:30 to 8:30	0	0	2	0	0	0	0	0	2
7:45 to 8:45	0	0	2	0	0	0	0	0	2
8:00 to 9:00	0	0	2	0	0	0	0	0	2
8:15 to 9:15	0	0	0	0	0	0	0	0	0
8:30 to 9:30	0	0	0	0	0	0	0	0	0
8:45 to 9:45	0	0	0	0	0	0	0	0	0
AM Totals	0	0	2	0	0	0	0	0	2
16:30 to 17:30	0	0	0	0	1	0	0	0	1
16:45 to 17:45	0	0	0	1	0	0	0	0	1
17:00 to 18:00	0	0	0	1	0	0	0	0	1
17:15 to 18:15	0	0	0	1	0	0	0	0	1
17:30 to 18:30	0	0	0	1	0	0	0	0	1
17:45 to 18:45	0	0	0	0	0	0	0	0	0
18:00 to 19:00	0	0	0	0	0	0	0	0	0
18:15 to 19:15	0	0	0	0	0	0	0	0	0
PM Totals	0	0	0	1	1	0	0	0	2

Job No.	:
Client	: Cardno
Suburb	: Homebush West
Location	: Centenary Dr / Hume Hwy
Day/Date	: Wednesday, 23 November 2016
Weather	: Fine
Description	: Classified Intersection Count
	: 15 mins Data

Classifications	**Class 1**	**Class 2**	**Class 3**	**Class 4**
	Cars	Trucks	N/A	N/A

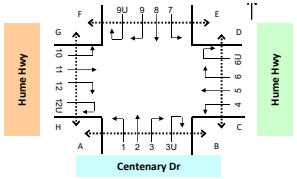


Approach	**Centenary Dr**																				**Hume Hwy**																			
Direction	**Direction 1 (Left Turn)**					**Direction 2 (Through)**					**Direction 3 (Right Turn)**					**Direction 3U (U Turn)**					**Direction 4 (Left Turn)**					**Direction 5 (Through)**					**Direction 6 (Right Turn)**					**Direction 6U (U Turn)**				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 7:15	44	3	0	0	**47**	0	0	0	0	**0**	138	13	0	0	**151**	0	0	0	0	**0**	18	0	0	0	**18**	233	8	0	0	**241**	31	10	0	0	**41**	0	0	0	0	**0**
7:15 to 7:30	49	5	0	0	**54**	0	0	0	0	**0**	142	13	0	0	**155**	0	0	0	0	**0**	11	4	0	0	**15**	231	22	0	0	**253**	27	12	0	0	**39**	0	0	0	0	**0**
7:30 to 7:45	41	3	0	0	**44**	1	0	0	0	**1**	164	14	0	0	**178**	0	0	0	0	**0**	21	4	0	0	**25**	276	18	0	0	**294**	49	10	0	0	**59**	0	0	0	0	**0**
7:45 to 8:00	25	3	0	0	**28**	0	0	0	0	**0**	124	12	0	0	**136**	0	0	0	0	**0**	17	9	0	0	**26**	375	13	0	0	**388**	40	6	0	0	**46**	0	0	0	0	**0**
8:00 to 8:15	34	4	0	0	**38**	0	0	0	0	**0**	138	15	0	0	**153**	0	0	0	0	**0**	25	1	0	0	**26**	301	16	0	0	**317**	48	11	0	0	**59**	0	0	0	0	**0**
8:15 to 8:30	30	3	0	0	**33**	0	1	0	0	**1**	139	12	0	0	**151**	0	0	0	0	**0**	31	0	0	0	**31**	374	32	0	0	**406**	68	10	0	0	**78**	0	0	0	0	**0**
8:30 to 8:45	28	3	0	0	**31**	1	0	0	0	**1**	118	14	0	0	**132**	0	0	0	0	**0**	48	3	0	0	**51**	368	19	0	0	**387**	63	7	0	0	**70**	0	0	0	0	**0**
8:45 to 9:00	50	2	0	0	**52**	1	0	0	0	**1**	145	5	0	0	**150**	0	0	0	0	**0**	36	1	0	0	**37**	322	27	0	0	**349**	80	8	0	0	**88**	0	0	0	0	**0**
AM Totals	**301**	**26**	**0**	**0**	**327**	**3**	**1**	**0**	**0**	**4**	**1,108**	**98**	**0**	**0**	**1,206**	**0**	**0**	**0**	**0**	**0**	**207**	**22**	**0**	**0**	**229**	**2,480**	**155**	**0**	**0**	**2,635**	**406**	**74**	**0**	**0**	**480**	**0**	**0**	**0**	**0**	**0**
16:30 to 16:45	41	7	0	0	**48**	1	0	0	0	**1**	208	12	0	0	**220**	0	0	0	0	**0**	35	2	0	0	**37**	380	17	0	0	**397**	82	10	0	0	**92**	0	0	0	0	**0**
16:45 to 17:00	48	7	0	0	**55**	0	0	0	0	**0**	222	13	0	0	**235**	0	0	0	0	**0**	34	7	0	0	**41**	380	25	0	0	**405**	92	4	0	0	**96**	0	0	0	0	**0**
17:00 to 17:15	32	8	0	0	**40**	0	0	0	0	**0**	199	14	0	0	**213**	0	0	0	0	**0**	40	4	0	0	**44**	381	18	0	0	**399**	82	5	0	0	**87**	0	0	0	0	**0**
17:15 to 17:30	49	4	0	0	**53**	0	0	0	0	**0**	165	6	0	0	**171**	0	0	0	0	**0**	23	4	0	0	**27**	371	14	0	0	**385**	97	5	0	0	**102**	0	0	0	0	**0**
17:30 to 17:45	37	5	0	0	**42**	0	0	0	0	**0**	186	8	0	0	**194**	0	0	0	0	**0**	47	3	0	0	**50**	342	12	0	0	**354**	86	4	0	0	**90**	0	0	0	0	**0**
17:45 to 18:00	51	6	0	0	**57**	0	0	0	0	**0**	195	8	0	0	**203**	0	0	0	0	**0**	30	1	0	0	**31**	326	17	0	0	**343**	115	6	0	0	**121**	0	0	0	0	**0**
18:00 to 18:15	63	6	0	0	**69**	0	0	0	0	**0**	145	5	0	0	**150**	0	0	0	0	**0**	43	0	0	0	**43**	418	14	0	0	**432**	81	11	0	0	**92**	0	0	0	0	**0**
18:15 to 18:30	39	7	0	0	**46**	1	0	0	0	**1**	210	11	0	0	**221**	0	0	0	0	**0**	41	1	0	0	**42**	345	16	0	0	**361**	79	4	0	0	**83**	0	0	0	0	**0**
PM Totals	**360**	**50**	**0**	**0**	**410**	**2**	**0**	**0**	**0**	**2**	**1,530**	**77**	**0**	**0**	**1,607**	**0**	**0**	**0**	**0**	**0**	**293**	**22**	**0**	**0**	**315**	**2,943**	**133**	**0**	**0**	**3,076**	**714**	**49**	**0**	**0**	**763**	**0**	**0**	**0**	**0**	**0**

Approach	**Centenary Dr**																				**Hume Hwy**																				**Crossing Pedestrians**									
Direction	**Direction 7 (Left Turn)**					**Direction 8 (Through)**					**Direction 9 (Right Turn)**					**Direction 9U (U Turn)**					**Direction 10 (Left Turn)**					**Direction 11 (Through)**					**Direction 12 (Right Turn)**					**Direction 12U (U Turn)**														
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	A	B	C	D	E	F	G	H	Total
7:00 to 7:15	20	11	0	0	**31**	8	1	0	0	**9**	94	5	0	0	**99**	0	0	0	0	**0**	108	11	0	0	**119**	390	20	0	0	**410**	17	9	0	0	**26**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:15 to 7:30	29	10	0	0	**39**	2	0	0	0	**2**	77	6	0	0	**83**	0	0	0	0	**0**	97	10	0	0	**107**	482	33	0	0	**515**	9	3	0	0	**12**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
7:30 to 7:45	33	5	0	0	**38**	2	1	0	0	**3**	106	3	0	0	**109**	0	0	0	0	**0**	63	9	0	0	**72**	411	23	0	0	**434**	12	10	0	0	**22**	0	0	0	0	**0**	0	0	0	0	3	0	0	0	**3**
7:45 to 8:00	43	13	0	0	**56**	4	2	0	0	**6**	109	3	0	0	**112**	0	0	0	0	**0**	98	6	0	0	**104**	508	28	0	0	**536**	8	6	0	0	**14**	0	0	0	0	**0**	0	0	0	0	0	1	0	0	**1**
8:00 to 8:15	34	22	0	0	**56**	1	0	0	0	**1**	117	5	0	0	**122**	0	0	0	0	**0**	65	7	0	0	**72**	428	20	0	0	**448**	16	11	0	0	**27**	0	0	0	0	**0**	0	0	0	0	0	3	0	0	**3**
8:15 to 8:30	37	11	0	0	**48**	6	1	0	0	**7**	133	6	0	0	**139**	0	0	0	0	**0**	60	16	0	0	**76**	369	13	0	0	**382**	9	5	0	0	**14**	0	0	0	0	**0**	0	0	0	0	4	0	0	0	**4**
8:30 to 8:45	47	7	0	0	**54**	4	1	0	0	**5**	140	0	0	0	**140**	0	0	0	0	**0**	88	16	0	0	**104**	368	19	0	0	**387**	15	8	0	0	**23**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
8:45 to 9:00	34	16	0	0	**50**	3	0	0	0	**3**	55	1	0	0	**56**	0	0	0	0	**0**	94	5	0	0	**99**	391	26	0	0	**417**	18	12	0	0	**30**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
AM Totals	**277**	**95**	**0**	**0**	**372**	**30**	**6**	**0**	**0**	**36**	**831**	**29**	**0**	**0**	**860**	**0**	**0**	**0**	**0**	**0**	**673**	**80**	**0**	**0**	**753**	**3,347**	**182**	**0**	**0**	**3,529**	**104**	**64**	**0**	**0**	**168**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**4**	**0**	**11**
16:30 to 16:45	19	7	0	0	**26**	3	0	0	0	**3**	44	1	0	0	**45**	0	0	0	0	**0**	104	6	0	0	**110**	322	9	0	0	**331**	24	2	0	0	**26**	0	0	0	0	**0**	0	0	0	0	1	0	0	0	**1**
16:45 to 17:00	15	6	0	0	**21**	1	0	0	0	**1**	43	2	0	0	**45**	0	0	0	0	**0**	97	12	0	0	**109**	370	10	0	0	**380**	11	7	0	0	**18**	0	0	0	0	**0**	0	0	0	0	0	1	0	0	**1**
17:00 to 17:15	25	6	0	0	**31**	4	0	0	0	**4**	33	6	0	0	**39**	0	0	0	0	**0**	98	6	0	0	**104**	425	7	0	0	**432**	19	5	0	0	**24**	0	0	0	0	**0**	0	0	0	0	2	1	0	0	**3**
17:15 to 17:30	21	7	0	0	**28**	1	0	0	0	**1**	35	3	0	0	**38**	0	0	0	0	**0**	82	4	0	0	**86**	408	12	0	0	**420**	12	1	0	0	**13**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:30 to 17:45	33	2	0	0	**35**	5	0	0	0	**5**	55	2	0	0	**57**	0	0	0	0	**0**	92	2	0	0	**94**	484	6	0	0	**490**	17	3	0	0	**20**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
17:45 to 18:00	18	5	0	0	**23**	2	0	0	0	**2**	34	0	0	0	**34**	0	0	0	0	**0**	88	4	0	0	**92**	401	12	0	0	**413**	17	6	0	0	**23**	0	0	0	0	**0**	0	0	0	0	1	0	0	0	**1**
18:00 to 18:15	16	8	0	0	**24**	1	0	0	0	**1**	36	1	0	0	**37**	0	0	0	0	**0**	135	5	0	0	**140**	353	7	0	0	**360**	12	1	0	0	**13**	0	0	0	0	**0**	0	0	0	0	0	0	0	0	**0**
18:15 to 18:30	19	1	0	0	**20**	0	0	0	0	**0**	40	1	0	0	**41**	0	0	0	0	**0**	129	2	0	0	**131**	302	6	0	0	**308**	18	1	0	0	**19**	0	0	0	0	**0**	0	0	0	0	0	2	0	0	**2**
PM Totals	**166**	**42**	**0**	**0**	**208**	**17**	**0**	**0**	**0**	**17**	**320**	**16**	**0**	**0**	**336**	**0**	**0**	**0**	**0**	**0**	**825**	**41**	**0**	**0**	**866**	**3,065**	**69**	**0**	**0**	**3,134**	**130**	**26**	**0**	**0**	**156**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**4**	**0**	**8**

Job No. :
Client : Cardno
Suburb : Homebush West
Location : Centenary Dr / Hume Hwy

Day/Date 42697
Weather : Fine
Description : Classified Intersection Count
: Hourly Summary



Approach	Centenary Dr																					Hume Hwy																					
Direction	Direction 1 (Left Turn)					Direction 2 (Through)					Direction 3 (Right Turn)					Direction 3U (U Turn)					Direction 4 (Left Turn)					Direction 5 (Through)					Direction 6 (Right Turn)					Direction 6U (U Turn)				
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total
7:00 to 8:00	159	14	0	0	173	1	0	0	0	1	568	52	0	0	620	0	0	0	0	0	67	17	0	0	84	1,115	61	0	0	1,176	147	38	0	0	185	0	0	0	0	0
7:15 to 8:15	149	15	0	0	164	1	0	0	0	1	568	54	0	0	622	0	0	0	0	0	74	18	0	0	92	1,183	69	0	0	1,252	164	39	0	0	203	0	0	0	0	0
7:30 to 8:30	130	13	0	0	143	1	1	0	0	2	565	53	0	0	618	0	0	0	0	0	94	14	0	0	108	1,326	79	0	0	1,405	205	37	0	0	242	0	0	0	0	0
7:45 to 8:45	117	13	0	0	130	1	1	0	0	2	519	53	0	0	572	0	0	0	0	0	121	13	0	0	134	1,418	80	0	0	1,498	219	34	0	0	253	0	0	0	0	0
8:00 to 9:00	142	12	0	0	154	2	1	0	0	3	540	46	0	0	586	0	0	0	0	0	140	5	0	0	145	1,365	94	0	0	1,459	259	36	0	0	295	0	0	0	0	0
8:15 to 9:15	108	8	0	0	116	2	1	0	0	3	402	31	0	0	433	0	0	0	0	0	115	4	0	0	119	1,064	78	0	0	1,142	211	25	0	0	236	0	0	0	0	0
8:30 to 9:30	78	5	0	0	83	2	0	0	0	2	263	19	0	0	282	0	0	0	0	0	84	4	0	0	88	690	46	0	0	736	143	15	0	0	158	0	0	0	0	0
8:45 to 9:45	50	2	0	0	52	1	0	0	0	1	145	5	0	0	150	0	0	0	0	0	36	1	0	0	37	322	27	0	0	349	80	8	0	0	88	0	0	0	0	0
AM Totals	**301**	**26**	**0**	**0**	**327**	**3**	**1**	**0**	**0**	**4**	**1,108**	**98**	**0**	**0**	**1,206**	**0**	**0**	**0**	**0**	**0**	**207**	**22**	**0**	**0**	**229**	**2,480**	**155**	**0**	**0**	**2,635**	**406**	**74**	**0**	**0**	**480**	**0**	**0**	**0**	**0**	**0**
16:30 to 17:30	170	26	0	0	196	1	0	0	0	1	794	45	0	0	839	0	0	0	0	0	132	17	0	0	149	1,512	74	0	0	1,586	353	24	0	0	377	0	0	0	0	0
16:45 to 17:45	166	24	0	0	190	0	0	0	0	0	772	41	0	0	813	0	0	0	0	0	144	18	0	0	162	1,474	69	0	0	1,543	357	18	0	0	375	0	0	0	0	0
17:00 to 18:00	169	23	0	0	192	0	0	0	0	0	745	36	0	0	781	0	0	0	0	0	140	12	0	0	152	1,420	61	0	0	1,481	380	20	0	0	400	0	0	0	0	0
17:15 to 18:15	200	21	0	0	221	0	0	0	0	0	691	27	0	0	718	0	0	0	0	0	143	8	0	0	151	1,457	57	0	0	1,514	379	26	0	0	405	0	0	0	0	0
17:30 to 18:30	190	24	0	0	214	1	0	0	0	1	736	32	0	0	768	0	0	0	0	0	161	5	0	0	166	1,431	59	0	0	1,490	361	25	0	0	386	0	0	0	0	0
17:45 to 18:45	153	19	0	0	172	1	0	0	0	1	550	24	0	0	574	0	0	0	0	0	114	2	0	0	116	1,089	47	0	0	1,136	275	21	0	0	296	0	0	0	0	0
18:00 to 19:00	102	13	0	0	115	1	0	0	0	1	355	16	0	0	371	0	0	0	0	0	84	1	0	0	85	763	30	0	0	793	160	15	0	0	175	0	0	0	0	0
18:15 to 19:15	39	7	0	0	46	1	0	0	0	1	210	11	0	0	221	0	0	0	0	0	41	1	0	0	42	345	16	0	0	361	79	4	0	0	83	0	0	0	0	0
PM Totals	**360**	**50**	**0**	**0**	**410**	**2**	**0**	**0**	**0**	**2**	**1,530**	**77**	**0**	**0**	**1,607**	**0**	**0**	**0**	**0**	**0**	**293**	**22**	**0**	**0**	**315**	**2,943**	**133**	**0**	**0**	**3,076**	**714**	**49**	**0**	**0**	**763**	**0**	**0**	**0**	**0**	**0**

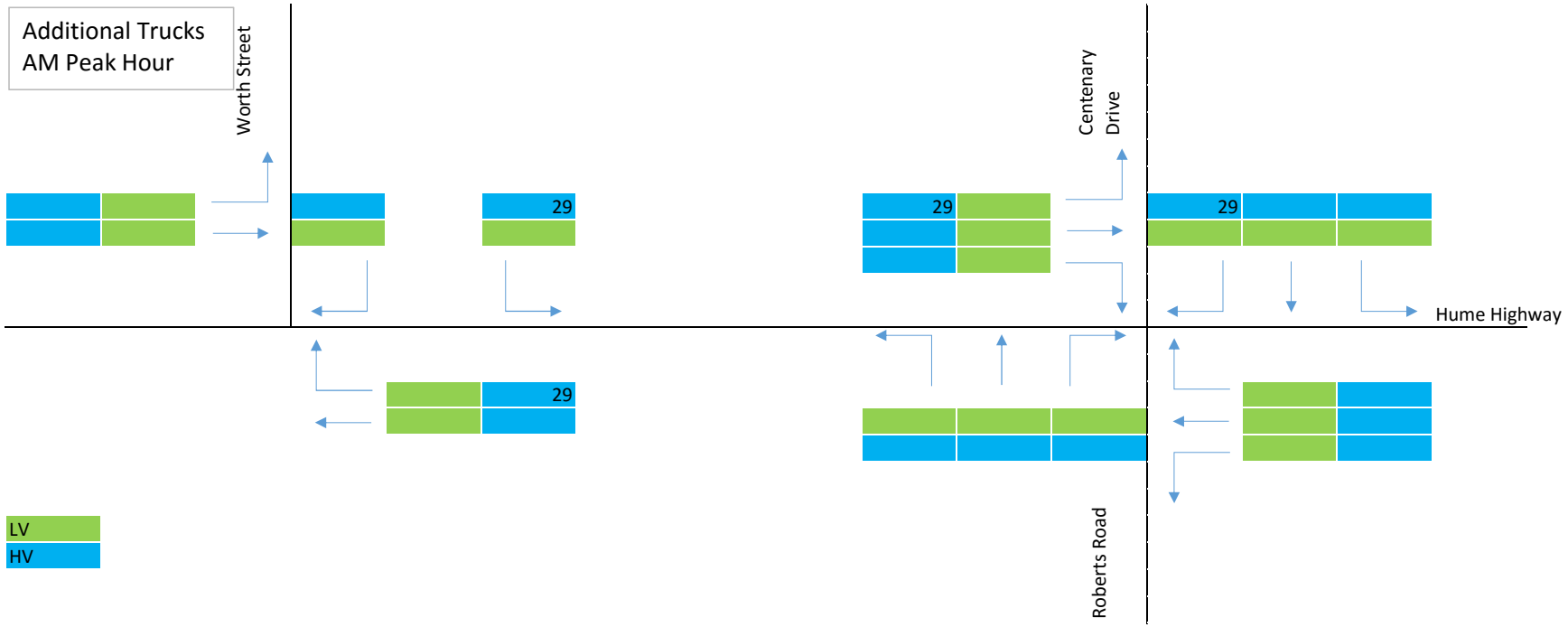
Approach	Centenary Dr																					Hume Hwy																					Crossing Pedestrians								
Direction	Direction 7 (Left Turn)					Direction 8 (Through)					Direction 9 (Right Turn)					Direction 9U (U Turn)					Direction 10 (Left Turn)					Direction 11 (Through)					Direction 12 (Right Turn)					Direction 12U (U Turn)													
Time Period	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	Cars	Trucks	N/A	N/A	Total	A	B	C	D	E	F	G	H	Total
7:00 to 8:00	125	39	0	0	164	16	4	0	0	20	386	17	0	0	403	0	0	0	0	0	366	36	0	0	402	1,791	104	0	0	1,895	46	28	0	0	74	0	0	0	0	0	0	0	0	0	3	1	0	0	4
7:15 to 8:15	139	50	0	0	189	9	3	0	0	12	409	17	0	0	426	0	0	0	0	0	323	32	0	0	355	1,829	104	0	0	1,933	45	30	0	0	75	0	0	0	0	0	0	0	0	0	3	4	0	0	7
7:30 to 8:30	147	51	0	0	198	13	4	0	0	17	465	17	0	0	482	0	0	0	0	0	286	38	0	0	324	1,716	84	0	0	1,800	45	32	0	0	77	0	0	0	0	0	0	0	0	0	7	4	0	0	11
7:45 to 8:45	161	53	0	0	214	15	4	0	0	19	499	14	0	0	513	0	0	0	0	0	311	45	0	0	356	1,673	80	0	0	1,753	48	30	0	0	78	0	0	0	0	0	0	0	0	0	4	4	0	0	8
8:00 to 9:00	152	56	0	0	208	14	2	0	0	16	445	12	0	0	457	0	0	0	0	0	307	44	0	0	351	1,556	78	0	0	1,634	58	36	0	0	94	0	0	0	0	0	0	0	0	0	4	3	0	0	7
8:15 to 9:15	118	34	0	0	152	13	2	0	0	15	328	7	0	0	335	0	0	0	0	0	242	37	0	0	279	1,128	58	0	0	1,186	42	25	0	0	67	0	0	0	0	0	0	0	0	0	4	0	0	0	4
8:30 to 9:30	81	23	0	0	104	7	1	0	0	8	195	1	0	0	196	0	0	0	0	0	182	21	0	0	203	759	45	0	0	804	33	20	0	0	53	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8:45 to 9:45	34	16	0	0	50	3	0	0	0	3	55	1	0	0	56	0	0	0	0	0	94	5	0	0	99	391	26	0	0	417	18	12	0	0	30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
AM Totals	**277**	**95**	**0**	**0**	**372**	**30**	**6**	**0**	**0**	**36**	**831**	**29**	**0**	**0**	**860**	**0**	**0**	**0**	**0**	**0**	**673**	**80**	**0**	**0**	**753**	**3,347**	**182**	**0**	**0**	**3,529**	**104**	**64**	**0**	**0**	**168**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**7**	**4**	**0**	**0**	**11**
16:30 to 17:30	80	26	0	0	106	9	0	0	0	9	155	12	0	0	167	0	0	0	0	0	381	28	0	0	409	1,525	38	0	0	1,563	66	15	0	0	81	0	0	0	0	0	0	0	0	0	3	2	0	0	5
16:45 to 17:45	94	21	0	0	115	11	0	0	0	11	166	13	0	0	179	0	0	0	0	0	369	24	0	0	393	1,687	35	0	0	1,722	59	16	0	0	75	0	0	0	0	0	0	0	0	0	2	2	0	0	4
17:00 to 18:00	97	20	0	0	117	12	0	0	0	12	157	11	0	0	168	0	0	0	0	0	360	16	0	0	376	1,718	37	0	0	1,755	65	15	0	0	80	0	0	0	0	0	0	0	0	0	3	1	0	0	4
17:15 to 18:15	88	22	0	0	110	9	0	0	0	9	160	6	0	0	166	0	0	0	0	0	397	15	0	0	412	1,646	37	0	0	1,683	58	11	0	0	69	0	0	0	0	0	0	0	0	0	1	0	0	0	1
17:30 to 18:30	86	16	0	0	102	8	0	0	0	8	165	4	0	0	169	0	0	0	0	0	444	13	0	0	457	1,540	31	0	0	1,571	64	11	0	0	75	0	0	0	0	0	0	0	0	0	1	2	0	0	3
17:45 to 18:45	53	14	0	0	67	3	0	0	0	3	110	2	0	0	112	0	0	0	0	0	352	11	0	0	363	1,056	25	0	0	1,081	47	8	0	0	55	0	0	0	0	0	0	0	0	0	1	2	0	0	3
18:00 to 19:00	35	9	0	0	44	1	0	0	0	1	76	2	0	0	78	0	0	0	0	0	264	7	0	0	271	655	13	0	0	668	30	2	0	0	32	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
18:15 to 19:15	19	1	0	0	20	0	0	0	0	0	40	1	0	0	41	0	0	0	0	0	129	2	0	0	131	302	6	0	0	308	18	1	0	0	19	0	0	0	0	0	0	0	0	0	0	2	0	0	0	2
PM Totals	**166**	**42**	**0**	**0**	**208**	**17**	**0**	**0**	**0**	**17**	**320**	**16**	**0**	**0**	**336**	**0**	**0**	**0**	**0**	**0**	**825**	**41**	**0**	**0**	**866**	**3,065**	**69**	**0**	**0**	**3,134**	**130**	**26**	**0**	**0**	**156**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**4**	**4**	**0**	**0**	**8**

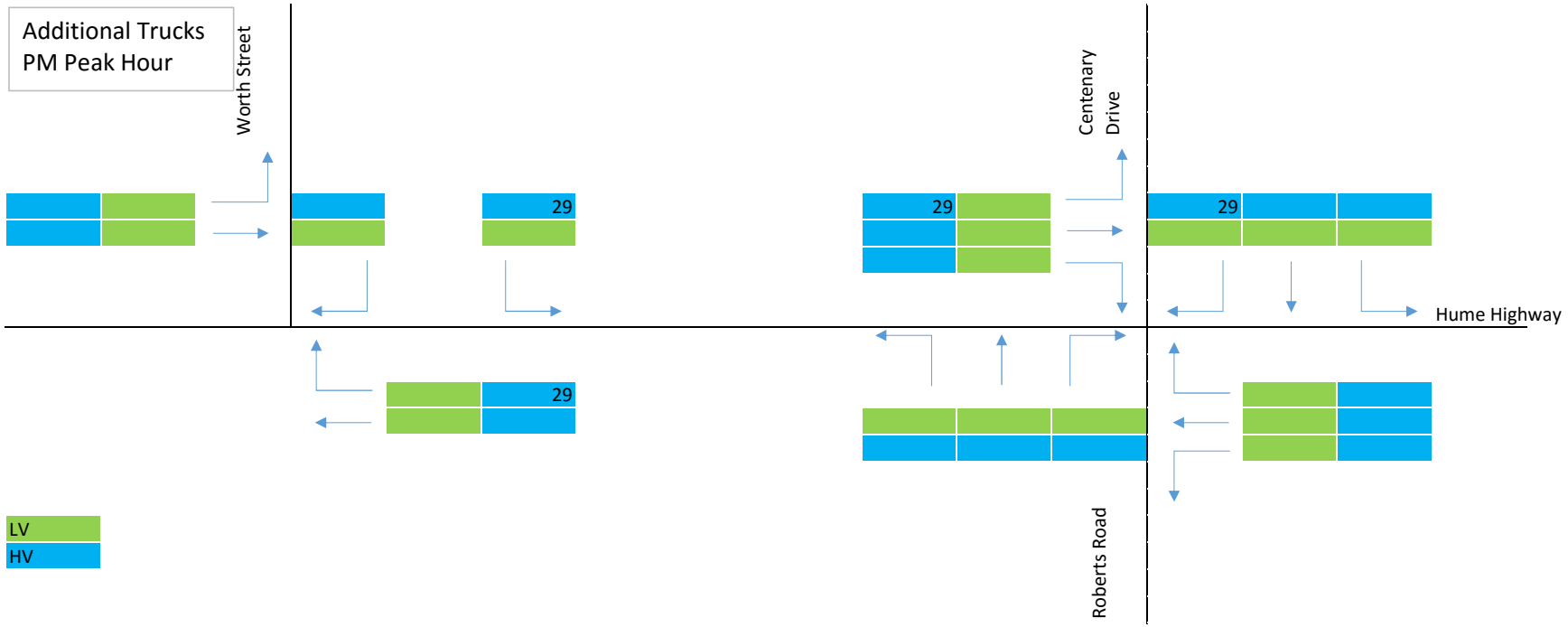
Spoil Management Pathway Project

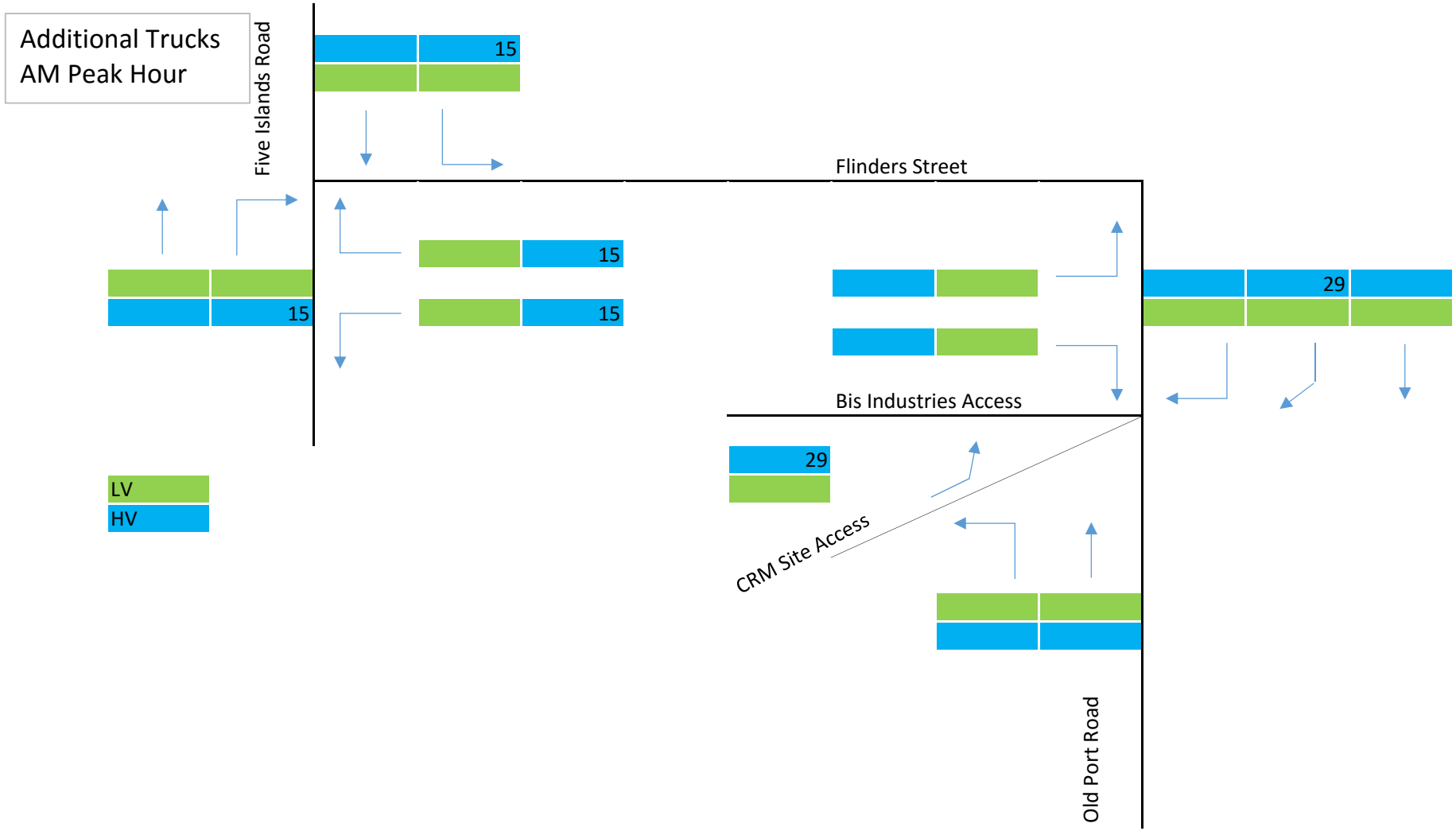
Appendix C

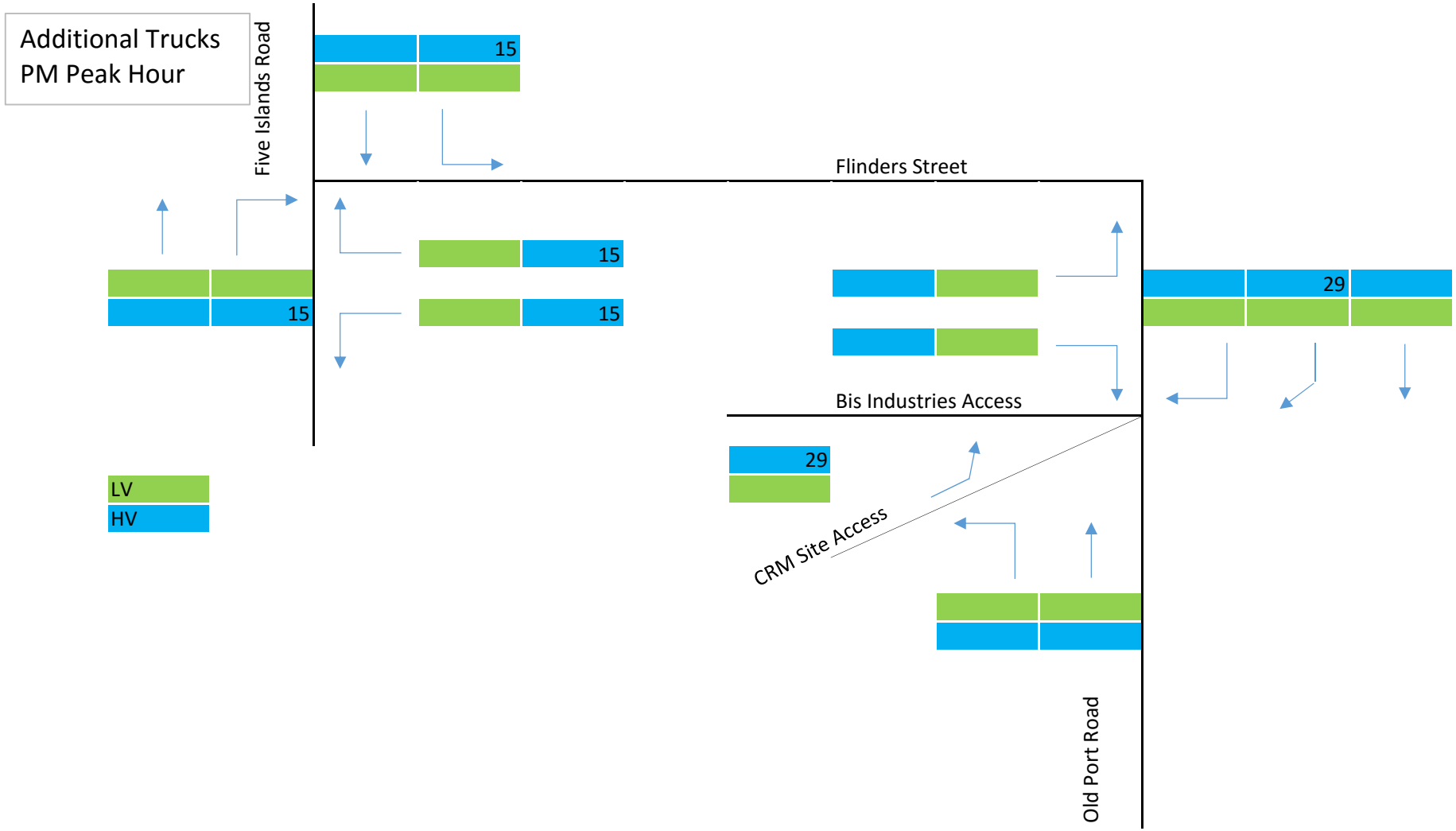
COMBINED VEHICLE TURNING FLOW DIAGRAM

Cardno
Shaping the Future


Additional Trucks
AM Peak Hour
Worth Street
Centenary Drive
Hume Highway
Roberts Road
29
29
29
29
LV
HV


Additional Trucks
PM Peak Hour
Worth Street
Centenary Drive
Hume Highway
Roberts Road
29
29
29
29
LV
HV


Additional Trucks
AM Peak Hour
Five Islands Road
Flinders Street
Bis Industries Access
CRM Site Access
Old Port Road
15
15
15
15
29
29
LV
HV


Additional Trucks
PM Peak Hour
Five Islands Road
Flinders Street
Bis Industries Access
CRM Site Access
Old Port Road
15
15
15
15
29
29
LV
HV

Spoil Management Pathway Project

Appendix D

SIDRA MOVEMENT SUMMARIES

Cardno
Shaping the Future

MOVEMENT SUMMARY

Site: 101 [Existing AM]

Hume Hwy / Worth St
Signals - Fixed Time Isolated Cycle Time = 140 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Hume Hwy											
8	T1	2022	5.5	0.482	7.6	LOS A	18.0	131.8	0.43	0.40	61.2
9	R2	391	12.5	0.726	55.7	LOS D	21.0	163.0	0.95	1.03	32.3
Approach		2413	6.7	0.726	15.4	LOS B	21.0	163.0	0.52	0.50	53.4
NorthWest: Worth St											
10	L2	356	6.7	0.201	5.7	LOS A	0.0	0.0	0.00	0.52	54.7
12	R2	19	10.5	0.032	57.4	LOS E	0.5	4.1	0.86	0.67	30.8
Approach		375	6.9	0.201	8.3	LOS A	0.5	4.1	0.04	0.53	52.6
SouthWest: Hume Hwy											
1	L2	23	26.1	0.015	7.0	LOS A	0.0	0.0	0.00	0.56	54.3
2	T1	1891	6.6	0.808	38.6	LOS C	38.3	282.9	0.94	0.86	40.3
Approach		1914	6.8	0.808	38.2	LOS C	38.3	282.9	0.93	0.86	40.5
All Vehicles		4702	6.8	0.808	24.1	LOS B	38.3	282.9	0.65	0.65	47.2

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P3	NorthEast Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	NorthWest Full Crossing	50	31.0	LOS D	0.1	0.1	0.67	0.67
All Pedestrians		100	47.6	LOS E			0.81	0.81

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Existing PM]

Hume Hwy / Worth St
Signals - Fixed Time Isolated Cycle Time = 140 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Hume Hwy											
8	T1	2144	3.6	0.505	7.8	LOS A	19.6	141.2	0.45	0.41	61.0
9	R2	423	11.3	0.706	51.2	LOS D	21.6	165.6	0.93	1.02	33.7
Approach		2567	4.9	0.706	14.9	LOS B	21.6	165.6	0.53	0.51	53.8
NorthWest: Worth St											
10	L2	424	6.6	0.239	5.7	LOS A	0.0	0.0	0.00	0.52	54.7
12	R2	31	16.1	0.054	57.9	LOS E	0.9	7.0	0.87	0.69	30.2
Approach		455	7.3	0.239	9.3	LOS A	0.9	7.0	0.06	0.54	51.8
SouthWest: Hume Hwy											
1	L2	19	0.0	0.010	6.7	LOS A	0.0	0.0	0.00	0.57	61.1
2	T1	1685	2.2	0.749	38.8	LOS C	32.9	234.7	0.92	0.83	40.2
Approach		1704	2.2	0.749	38.5	LOS C	32.9	234.7	0.91	0.82	40.4
All Vehicles		4726	4.1	0.749	22.9	LOS B	32.9	234.7	0.62	0.63	47.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P3	NorthEast Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	NorthWest Full Crossing	1	33.6	LOS D	0.0	0.0	0.69	0.69
All Pedestrians		51	63.7	LOS F			0.95	0.95

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Existing + Additional Trucks AM]

Hume Hwy / Worth St
Signals - Fixed Time Isolated Cycle Time = 140 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Hume Hwy											
8	T1	2022	5.5	0.482	7.6	LOS A	18.0	131.8	0.43	0.40	61.2
9	R2	420	18.6	0.805	58.8	LOS E	24.0	214.5	0.97	1.06	31.3
Approach		2442	7.8	0.805	16.4	LOS B	24.0	214.5	0.53	0.51	52.5
NorthWest: Worth St											
10	L2	385	13.8	0.259	5.8	LOS A	0.0	0.0	0.00	0.52	54.3
12	R2	19	10.5	0.032	57.4	LOS E	0.5	4.1	0.86	0.67	30.8
Approach		404	13.6	0.259	8.2	LOS A	0.5	4.1	0.04	0.53	52.4
SouthWest: Hume Hwy											
1	L2	23	26.1	0.015	7.0	LOS A	0.0	0.0	0.00	0.56	54.3
2	T1	1891	6.6	0.900	56.9	LOS E	47.4	350.3	1.00	1.03	33.6
Approach		1914	6.8	0.900	56.3	LOS D	47.4	350.3	0.99	1.02	33.7
All Vehicles		4760	7.9	0.900	31.7	LOS C	47.4	350.3	0.67	0.72	42.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P3	NorthEast Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	NorthWest Full Crossing	50	35.1	LOS D	0.1	0.1	0.71	0.71
All Pedestrians		100	49.7	LOS E			0.83	0.83

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Existing + Additional Trucks PM]

Hume Hwy / Worth St
Signals - Fixed Time Isolated Cycle Time = 140 seconds (User-Given Cycle Time)

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	95% Back of Queue Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
NorthEast: Hume Hwy											
8	T1	2144	3.6	0.505	7.8	LOS A	19.6	141.2	0.45	0.41	61.0
9	R2	452	17.0	0.771	51.0	LOS D	23.6	207.6	0.93	1.03	33.6
Approach		2596	5.9	0.771	15.3	LOS B	23.6	207.6	0.53	0.52	53.4
NorthWest: Worth St											
10	L2	453	12.6	0.297	5.8	LOS A	0.0	0.0	0.00	0.52	54.3
12	R2	31	16.1	0.054	57.9	LOS E	0.9	7.0	0.87	0.69	30.2
Approach		484	12.8	0.297	9.1	LOS A	0.9	7.0	0.06	0.53	51.7
SouthWest: Hume Hwy											
1	L2	19	0.0	0.010	6.7	LOS A	0.0	0.0	0.00	0.57	61.1
2	T1	1685	2.2	0.859	52.3	LOS D	38.9	277.4	1.00	0.97	35.1
Approach		1704	2.2	0.859	51.8	LOS D	38.9	277.4	0.99	0.96	35.2
All Vehicles		4784	5.3	0.859	27.7	LOS B	38.9	277.4	0.65	0.68	45.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Average Back of Queue Distance m	Prop. Queued	Effective Stop Rate per ped
P3	NorthEast Full Crossing	50	64.3	LOS F	0.2	0.2	0.96	0.96
P4	NorthWest Full Crossing	50	38.7	LOS D	0.1	0.1	0.74	0.74
All Pedestrians		100	51.5	LOS E			0.85	0.85

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 101 [Existing (E) AM]

Network: N101 [Existing AM]

New Site
Signals - Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Hume Hwy													
5	T1	1632	5.7	1632	5.7	0.775	19.3	LOS B	30.7	225.5	0.83	0.75	37.2
6	R2	253	13.4	253	13.4	0.498	50.9	LOS D	5.9	45.9	0.94	0.79	32.3
Approach		1885	6.7	1885	6.7	0.775	23.5	LOS B	30.7	225.5	0.84	0.76	35.9
North: Centenary Dr													
7	L2	214	24.8	214	24.8	0.259	19.3	LOS B	5.5	47.0	0.57	0.73	44.7
9	R2	532	3.4	532	3.4	1.467	902.9	LOS F	84.2	606.3	1.00	3.58	2.0
Approach		746	9.5	746	9.5	1.467	649.4	LOS F	84.2	606.3	0.88	2.76	3.5
West: Hume Hwy													
10	L2	356	12.6	356	12.6	0.286	12.5	LOS A	9.6	74.7	0.59	0.75	43.6
11	T1	2325	5.7	2151	5.4	0.928	38.4	LOS C	11.1	81.6	0.99	1.00	28.3
Approach		2681	6.6	2507 N1	6.5	0.928	34.8	LOS C	11.1	81.6	0.94	0.96	29.8
All Vehicles		5312	7.1	5138 N1	7.3	1.467	119.9	LOS F	84.2	606.3	0.89	1.15	13.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.5 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P31	North Stage 1	50	16.3	LOS B	0.1	0.1	0.57	0.57
P32	North Stage 2	50	13.8	LOS B	0.1	0.1	0.69	0.69
P4S	West Slip/Bypass Lane Crossing	50	11.5	LOS B	0.1	0.1	0.64	0.64
All Pedestrians		150	13.8	LOS B			0.63	0.63

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [Existing (W) AM]

Network: N101 [Existing AM]

New Site
Signals - Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Centenary Dr													
1	L2	130	10.0	130	10.0	0.139	15.1	LOS B	2.8	20.9	0.49	0.67	47.3
3	R2	572	9.3	572	9.3	1.642	1218.4	LOS F	107.4	811.6	1.00	4.01	1.5
Approach		702	9.4	702	9.4	1.642	995.6	LOS F	107.4	811.6	0.91	3.39	2.1
East: Hume Hwy													
4	L2	153	11.1	145	11.3	0.153	10.3	LOS A	2.0	15.4	0.49	0.67	44.8
5	T1	2011	4.7	1901	4.8	0.957	41.6	LOS C	11.2	81.6	1.00	1.04	27.0
Approach		2164	5.1	2046 N1	5.2	0.957	39.3	LOS C	11.2	81.6	0.96	1.01	27.8
West: Hume Hwy													
11	T1	2109	5.9	2109	5.9	0.942	29.5	LOS C	35.9	260.9	0.84	0.91	31.8
12	R2	78	38.5	78	38.5	0.255	26.5	LOS B	2.1	19.5	0.85	0.74	40.6
Approach		2187	7.1	2187	7.1	0.942	29.3	LOS C	35.9	260.9	0.84	0.91	31.3
All Vehicles		5053	6.6	4935 N1	6.7	1.642	170.9	LOS F	107.4	811.6	0.90	1.30	9.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.5 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	27.4	LOS C	0.1	0.1	0.74	0.74
P2S	East Slip/Bypass Lane Crossing	50	9.3	LOS A	0.1	0.1	0.43	0.43
P41	West Stage 1	50	42.4	LOS E	0.1	0.1	0.92	0.92
P42	West Stage 2	50	14.6	LOS B	0.1	0.1	0.54	0.54
All Pedestrians		200	23.4	LOS C			0.66	0.66

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

NETWORK SUMMARY

Network: N101 [Existing AM]

New Network
Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Network Performance - Hourly Values								
Performance Measure	**Vehicles**		**Per Unit Distance**		**Pedestrians**		**Persons**	
Network Level of Service (LOS)	LOS F							
Travel Time Index	1.03							
Speed Efficiency	0.19							
Congestion Coefficient	5.19							
Travel Speed (Average)	11.6	km/h			2.5	km/h	11.5	km/h
Travel Distance (Total)	5808.2	veh-km/h			10.5	ped-km/h	6980.3	pers-km/h
Travel Time (Total)	502.7	veh-h/h			4.1	ped-h/h	607.3	pers-h/h
Desired Speed	60.0	km/h						
Demand Flows (Total for all Sites)	10365	veh/h			350	ped/h	12438	pers/h
Arrival Flows (Total for all Sites)	10072	veh/h			350	ped/h	12087	pers/h
Percent Heavy Vehicles (Demand)	6.8	%						
Percent Heavy Vehicles (Arrival)	7.0	%						
Degree of Saturation	1.642							
Control Delay (Total)	405.42	veh-h/h			1.88	ped-h/h	488.39	pers-h/h
Control Delay (Average)	144.9	sec			19.3	sec	145.5	sec
Control Delay (Worst Lane)	1218.4	sec						
Control Delay (Worst Movement)	1218.4	sec			42.4	sec	1218.4	sec
Geometric Delay (Average)	1.2	sec						
Stop-Line Delay (Average)	143.7	sec						
Queue Storage Ratio (Worst Lane)	1.00							
Total Effective Stops	12320	veh/h			227	ped/h	15011	pers/h
Effective Stop Rate	1.22	per veh	2.1	per km	0.65	per ped	1.24	per pers
Proportion Queued	0.90				0.65		0.94	
Performance Index	946.9				5.4		952.3	
Cost (Total)	17149.52	$/h	2.95	$/km	103.71	$/h	17253.23	$/h
Fuel Consumption (Total)	1306.8	L/h	225.0	mL/km				
Fuel Economy	22.5	L/100km						
Carbon Dioxide (Total)	3110.7	kg/h	535.6	g/km				
Hydrocarbons (Total)	0.365	kg/h	0.063	g/km				
Carbon Monoxide (Total)	3.181	kg/h	0.548	g/km				
NOx (Total)	6.791	kg/h	1.169	g/km				

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.5 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Setup used: New South Wales.

Network Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total for all Sites)	4,975,200	veh/y	168,000	ped/y	5,970,241	pers/y
Delay	194,603	veh-h/y	902	ped-h/y	234,425	pers-h/y
Effective Stops	5,913,789	veh/y	108,947	ped/y	7,205,494	pers/y
Travel Distance	2,787,915	veh-km/y	5,026	ped-km/y	3,350,524	pers-km/y
Travel Time	241,275	veh-h/y	1,975	ped-h/y	291,505	pers-h/y
Cost	8,231,771	$/y	49,779	$/y	8,281,549	$/y
Fuel Consumption	627,249	L/y				
Carbon Dioxide	1,493,134	kg/y				
Hydrocarbons	175	kg/y				
Carbon Monoxide	1,527	kg/y				

NOx	3,260 kg/y

MOVEMENT SUMMARY

Site: 101 [Existing (E) PM]

Network: N101 [Existing PM]

New Site
Signals - Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Hume Hwy													
5	T1	1705	5.1	1705	5.1	0.587	5.4	LOS A	17.2	125.3	0.45	0.41	51.2
6	R2	375	4.8	375	4.8	0.949	62.2	LOS E	10.2	74.6	1.00	0.90	29.5
Approach		2080	5.0	2080	5.0	0.949	15.6	LOS B	17.2	125.3	0.55	0.50	41.9
North: Centenary Dr													
7	L2	115	18.3	115	18.3	0.154	17.3	LOS B	2.6	21.3	0.55	0.69	45.9
9	R2	190	6.8	190	6.8	0.975	71.9	LOS F	5.8	43.2	1.00	0.95	18.3
Approach		305	11.1	305	11.1	0.975	51.3	LOS D	5.8	43.2	0.83	0.85	27.1
West: Hume Hwy													
10	L2	393	6.1	393	6.1	0.287	10.2	LOS A	9.2	67.5	0.51	0.73	46.1
11	T1	2535	3.0	2383	2.9	0.902	18.0	LOS B	11.4	81.6	0.95	0.89	39.4
Approach		2928	3.4	2776 N1	3.3	0.902	16.9	LOS B	11.4	81.6	0.89	0.87	40.3
All Vehicles		5313	4.5	5161 N1	4.6	0.975	18.4	LOS B	17.2	125.3	0.75	0.72	39.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 10.0 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P31	North Stage 1	50	7.3	LOS A	0.0	0.0	0.54	0.54
P32	North Stage 2	50	13.8	LOS B	0.1	0.1	0.68	0.68
P4S	West Slip/Bypass Lane Crossing	50	18.1	LOS B	0.1	0.1	0.85	0.85
All Pedestrians		150	13.1	LOS B			0.69	0.69

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [Existing (W) PM]

Network: N101 [Existing PM]

New Site
Signals - Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Centenary Dr													
1	L2	190	12.6	190	12.6	0.200	14.8	LOS B	4.4	33.9	0.51	0.69	47.4
3	R2	813	5.0	813	5.0	1.374	732.4	LOS F	114.2	834.0	1.00	3.12	2.5
Approach		1003	6.5	1003	6.5	1.374	596.5	LOS F	114.2	834.0	0.91	2.66	3.5
East: Hume Hwy													
4	L2	173	10.4	173	10.4	0.130	7.9	LOS A	2.7	20.4	0.33	0.63	47.3
5	T1	1722	4.8	1722	4.8	0.799	32.1	LOS C	11.2	81.6	0.95	0.85	30.8
Approach		1895	5.3	1895	5.3	0.799	29.9	LOS C	11.2	81.6	0.90	0.83	31.9
West: Hume Hwy													
11	T1	2115	2.8	2115	2.8	1.103	196.4	LOS F	84.3	600.2	0.94	2.00	12.9
12	R2	75	21.3	75	21.3	0.423	54.4	LOS D	3.6	29.8	0.95	0.76	31.2
Approach		2190	3.4	2190	3.4	1.103	191.5	LOS F	84.3	600.2	0.94	1.95	8.6
All Vehicles		5088	4.7	5088	4.7	1.374	211.2	LOS F	114.2	834.0	0.92	1.67	8.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 10.0 %
Number of Iterations: 10 (maximum specified: 10)

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	25.3	LOS C	0.1	0.1	0.71	0.71
P2S	East Slip/Bypass Lane Crossing	50	14.2	LOS B	0.1	0.1	0.74	0.74
P41	West Stage 1	50	31.3	LOS D	0.1	0.1	0.79	0.79
P42	West Stage 2	50	16.3	LOS B	0.1	0.1	0.57	0.57
All Pedestrians		200	21.8	LOS C			0.70	0.70

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

NETWORK SUMMARY

Network: N101 [Existing PM]

New Network
Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Network Performance - Hourly Values								
Performance Measure	**Vehicles**		**Per Unit Distance**		**Pedestrians**		**Persons**	
Network Level of Service (LOS)	LOS F							
Travel Time Index	1.48							
Speed Efficiency	0.23							
Congestion Coefficient	4.28							
Travel Speed (Average)	14.0	km/h			2.6	km/h	13.9	km/h
Travel Distance (Total)	5946.8	veh-km/h			10.5	ped-km/h	7146.7	pers-km/h
Travel Time (Total)	424.3	veh-h/h			4.0	ped-h/h	513.2	pers-h/h
Desired Speed	60.0	km/h						
Demand Flows (Total for all Sites)	10401	veh/h			350	ped/h	12481	pers/h
Arrival Flows (Total for all Sites)	10249	veh/h			350	ped/h	12299	pers/h
Percent Heavy Vehicles (Demand)	4.6	%						
Percent Heavy Vehicles (Arrival)	4.7	%						
Degree of Saturation	1.374							
Control Delay (Total)	324.82	veh-h/h			1.75	ped-h/h	391.54	pers-h/h
Control Delay (Average)	114.1	sec			18.0	sec	114.6	sec
Control Delay (Worst Lane)	732.4	sec						
Control Delay (Worst Movement)	732.4	sec			31.3	sec	732.4	sec
Geometric Delay (Average)	1.2	sec						
Stop-Line Delay (Average)	112.9	sec						
Queue Storage Ratio (Worst Lane)	1.02							
Total Effective Stops	12216	veh/h			245	ped/h	14904	pers/h
Effective Stop Rate	1.19	per veh	2.1	per km	0.70	per ped	1.21	per pers
Proportion Queued	0.83				0.70		0.86	
Performance Index	839.5				5.3		844.9	
Cost (Total)	14495.11	$/h	2.44	$/km	100.58	$/h	14595.69	$/h
Fuel Consumption (Total)	1135.6	L/h	191.0	mL/km				
Fuel Economy	19.1	L/100km						
Carbon Dioxide (Total)	2692.0	kg/h	452.7	g/km				
Hydrocarbons (Total)	0.292	kg/h	0.049	g/km				
Carbon Monoxide (Total)	2.620	kg/h	0.441	g/km				
NOx (Total)	4.448	kg/h	0.748	g/km				

Network Model Accuracy Level (largest change in degree of saturation for any lane): 10.0 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Setup used: New South Wales.

Network Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total for all Sites)	4,992,480	veh/y	168,000	ped/y	5,990,976	pers/y
Delay	155,914	veh-h/y	842	ped-h/y	187,939	pers-h/y
Effective Stops	5,863,861	veh/y	117,365	ped/y	7,153,998	pers/y
Travel Distance	2,854,479	veh-km/y	5,026	ped-km/y	3,430,400	pers-km/y
Travel Time	203,679	veh-h/y	1,916	ped-h/y	246,330	pers-h/y
Cost	6,957,654	$/y	48,276	$/y	7,005,930	$/y
Fuel Consumption	545,083	L/y				
Carbon Dioxide	1,292,169	kg/y				
Hydrocarbons	140	kg/y				
Carbon Monoxide	1,258	kg/y				

NOx	2,135 kg/y

MOVEMENT SUMMARY

Site: 101 [Existing + Additional Trucks (E) AM]

Network: N101 [Existing + Additional Trucks AM]

New Site
Signals - Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Hume Hwy													
5	T1	1632	5.7	1632	5.7	0.775	19.3	LOS B	30.7	225.5	0.83	0.75	37.2
6	R2	253	13.4	253	13.4	0.467	49.7	LOS D	5.8	45.2	0.93	0.78	32.6
Approach		1885	6.7	1885	6.7	0.775	23.4	LOS B	30.7	225.5	0.84	0.76	36.0
North: Centenary Dr													
7	L2	214	24.8	214	24.8	0.255	18.8	LOS B	5.4	45.8	0.56	0.72	44.9
9	R2	561	8.4	561	8.4	1.759	1429.8	LOS F	114.7	931.6	1.00	4.50	1.3
Approach		775	12.9	775	12.9	1.759	1040.2	LOS F	114.7	931.6	0.88	3.46	2.2
West: Hume Hwy													
10	L2	385	19.2	385	19.2	0.371	11.8	LOS A	9.0	81.6	0.53	0.73	43.8
11	T1	2325	5.7	2151	5.4	0.951	45.3	LOS D	11.1	81.6	1.00	1.06	25.9
Approach		2710	7.6	2536[N1]	7.5	0.951	40.2	LOS C	11.1	81.6	0.93	1.01	27.6
All Vehicles		5370	8.1	5196[N1]	8.4	1.759	183.3	LOS F	114.7	931.6	0.89	1.28	9.7

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.7 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P31	North Stage 1	50	16.9	LOS B	0.1	0.1	0.58	0.58
P32	North Stage 2	50	13.5	LOS B	0.1	0.1	0.69	0.69
P4S	West Slip/Bypass Lane Crossing	50	11.3	LOS B	0.1	0.1	0.64	0.64
All Pedestrians		150	13.9	LOS B			0.64	0.64

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [Existing + Additional Trucks (W) AM]

Network: N101 [Existing + Additional Trucks AM]

New Site
Signals - Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Centenary Dr													
1	L2	130	10.0	130	10.0	0.136	8.9	LOS A	2.7	20.4	0.48	0.39	47.6
3	R2	572	9.3	572	9.3	1.642	1212.7	LOS F	107.4	811.6	1.00	4.01	1.5
Approach		702	9.4	702	9.4	1.642	989.8	LOS F	107.4	811.6	0.90	3.34	2.1
East: Hume Hwy													
4	L2	153	11.1	140	11.4	0.151	8.1	LOS A	2.6	20.0	0.64	0.52	43.1
5	T1	2011	4.7	1837	4.8	0.953	49.6	LOS D	11.2	81.6	1.00	1.05	24.4
Approach		2164	5.1	1977 N1	5.3	0.953	46.6	LOS D	11.2	81.6	0.97	1.02	25.2
West: Hume Hwy													
11	T1	2138	7.2	2138	7.2	0.943	30.3	LOS C	36.3	263.9	0.87	0.94	31.2
12	R2	78	38.5	78	38.5	0.243	19.9	LOS B	2.0	19.1	0.84	0.65	40.9
Approach		2216	8.3	2216	8.3	0.943	29.9	LOS C	36.3	263.9	0.87	0.93	30.9
All Vehicles		5082	7.1	4895 N1	7.4	1.642	174.3	LOS F	107.4	811.6	0.92	1.31	9.6

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay does not include Geometric Delay since Exclude Geometric Delay option is selected.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.7 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	28.2	LOS C	0.1	0.1	0.75	0.75
P2S	East Slip/Bypass Lane Crossing	50	8.8	LOS A	0.1	0.1	0.42	0.42
P41	West Stage 1	50	42.4	LOS E	0.1	0.1	0.92	0.92
P42	West Stage 2	50	14.1	LOS B	0.1	0.1	0.53	0.53
All Pedestrians		200	23.4	LOS C			0.66	0.66

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

NETWORK SUMMARY

Network: N101 [Existing + Additional Trucks AM]

New Network
Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Network Performance - Hourly Values								
Performance Measure	**Vehicles**		**Per Unit Distance**		**Pedestrians**		**Persons**	
Network Level of Service (LOS)	LOS F							
Travel Time Index	0.68							
Speed Efficiency	0.16							
Congestion Coefficient	6.19							
Travel Speed (Average)	9.7	km/h			2.5	km/h	9.6	km/h
Travel Distance (Total)	5816.3	veh-km/h			10.5	ped-km/h	6990.0	pers-km/h
Travel Time (Total)	600.3	veh-h/h			4.1	ped-h/h	724.5	pers-h/h
Desired Speed	60.0	km/h						
Demand Flows (Total for all Sites)	10452	veh/h			350	ped/h	12542	pers/h
Arrival Flows (Total for all Sites)	10091	veh/h			350	ped/h	12109	pers/h
Percent Heavy Vehicles (Demand)	7.6	%						
Percent Heavy Vehicles (Arrival)	7.9	%						
Degree of Saturation	1.759							
Control Delay (Total)	501.54	veh-h/h			1.88	ped-h/h	603.72	pers-h/h
Control Delay (Average)	178.9	sec			19.3	sec	179.5	sec
Control Delay (Worst Lane)	1429.8	sec						
Control Delay (Worst Movement)	1429.8	sec			42.4	sec	1429.8	sec
Geometric Delay (Average)	0.7	sec						
Stop-Line Delay (Average)	178.2	sec						
Queue Storage Ratio (Worst Lane)	1.14							
Total Effective Stops	13087	veh/h			227	ped/h	15932	pers/h
Effective Stop Rate	1.30	per veh	2.3	per km	0.65	per ped	1.32	per pers
Proportion Queued	0.90				0.65		0.95	
Performance Index	1172.8				5.4		1178.2	
Cost (Total)	20528.09	$/h	3.53	$/km	103.67	$/h	20631.75	$/h
Fuel Consumption (Total)	1499.6	L/h	257.8	mL/km				
Fuel Economy	25.8	L/100km						
Carbon Dioxide (Total)	3574.3	kg/h	614.5	g/km				
Hydrocarbons (Total)	0.445	kg/h	0.076	g/km				
Carbon Monoxide (Total)	3.763	kg/h	0.647	g/km				
NOx (Total)	8.763	kg/h	1.507	g/km				

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.7 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Setup used: New South Wales.

Network Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total for all Sites)	5,016,960	veh/y	168,000	ped/y	6,020,352	pers/y
Delay	240,738	veh-h/y	901	ped-h/y	289,787	pers-h/y
Effective Stops	6,281,849	veh/y	108,947	ped/y	7,647,168	pers/y
Travel Distance	2,791,800	veh-km/y	5,026	ped-km/y	3,355,186	pers-km/y
Travel Time	288,166	veh-h/y	1,975	ped-h/y	347,774	pers-h/y
Cost	9,853,481	$/y	49,761	$/y	9,903,242	$/y
Fuel Consumption	719,801	L/y				
Carbon Dioxide	1,715,687	kg/y				
Hydrocarbons	213	kg/y				
Carbon Monoxide	1,806	kg/y				

NOx	4,206 kg/y

MOVEMENT SUMMARY

Site: 101 [Existing + Additional Trucks (E) PM]

Network: N101 [Existing + Additional Trucks PM]

New Site
Signals - Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
East: Hume Hwy													
5	T1	1705	5.1	1705	5.1	0.594	5.9	LOS A	17.9	130.8	0.47	0.43	50.6
6	R2	375	4.8	375	4.8	1.160	352.5	LOS F	31.4	228.8	1.00	1.99	8.9
Approach		2080	5.0	2080	5.0	1.160	68.3	LOS E	31.4	228.8	0.56	0.71	20.9
North: Centenary Dr													
7	L2	115	18.3	115	18.3	0.157	16.9	LOS B	2.6	21.0	0.54	0.69	46.1
9	R2	219	19.2	219	19.2	1.380	751.9	LOS F	31.0	301.9	1.00	2.72	2.4
Approach		334	18.9	334	18.9	1.380	498.8	LOS F	31.0	301.9	0.84	2.02	4.6
West: Hume Hwy													
10	L2	422	12.6	422	12.6	0.353	8.5	LOS A	8.0	68.3	0.41	0.70	47.3
11	T1	2535	3.0	2386	2.9	0.884	15.9	LOS B	11.4	81.6	0.93	0.86	41.1
Approach		2957	4.4	2808 N1	4.4	0.884	14.8	LOS B	11.4	81.6	0.85	0.83	41.9
All Vehicles		5371	5.5	5222 N1	5.7	1.380	67.1	LOS E	31.4	301.9	0.74	0.86	20.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.5 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P31	North Stage 1	50	7.1	LOS A	0.0	0.0	0.53	0.53
P32	North Stage 2	50	13.5	LOS B	0.1	0.1	0.66	0.66
P4S	West Slip/Bypass Lane Crossing	50	17.7	LOS B	0.1	0.1	0.84	0.84
All Pedestrians		150	12.8	LOS B			0.68	0.68

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

MOVEMENT SUMMARY

Site: 102 [Existing + Additional Trucks (W) PM]

Network: N101 [Existing + Additional Trucks PM]

New Site
Signals - Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Movement Performance - Vehicles

Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Arrival Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Centenary Dr													
1	L2	190	12.6	190	12.6	0.199	14.5	LOS A	4.3	33.5	0.50	0.69	47.7
3	R2	813	5.0	813	5.0	1.308	612.2	LOS F	103.1	753.1	1.00	2.83	2.9
Approach		1003	6.5	1003	6.5	1.308	499.0	LOS F	103.1	753.1	0.91	2.42	4.1
East: Hume Hwy													
4	L2	173	10.4	170	10.4	0.124	7.3	LOS A	2.5	18.8	0.31	0.62	47.9
5	T1	1722	4.8	1692	4.7	0.785	31.6	LOS C	11.2	81.6	0.94	0.84	31.1
Approach		1895	5.3	1862[N1]	5.2	0.785	29.4	LOS C	11.2	81.6	0.89	0.82	32.1
West: Hume Hwy													
11	T1	2144	4.1	2144	4.1	1.142	250.5	LOS F	97.6	695.4	0.97	2.29	11.5
12	R2	75	21.3	75	21.3	0.517	57.1	LOS E	3.7	30.8	0.97	0.76	30.5
Approach		2219	4.7	2219	4.7	1.142	243.9	LOS F	97.6	695.4	0.97	2.23	7.0
All Vehicles		5117	5.3	5084[N1]	5.3	1.308	215.7	LOS F	103.1	753.1	0.92	1.75	8.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Network Data dialog (Network tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.
Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.5 %
Number of Iterations: 10 (maximum specified: 10)

N1 Arrival Flow value is reduced due to capacity constraint at oversaturated upstream lanes.

Movement Performance - Pedestrians

Mov ID	Description	Demand Flow ped/h	Average Delay sec	Level of Service	Average Back of Queue Pedestrian ped	Distance m	Prop. Queued	Effective Stop Rate per ped
P1	South Full Crossing	50	25.3	LOS C	0.1	0.1	0.71	0.71
P2S	East Slip/Bypass Lane Crossing	50	14.5	LOS B	0.1	0.1	0.75	0.75
P41	West Stage 1	50	29.7	LOS C	0.1	0.1	0.77	0.77
P42	West Stage 2	50	16.3	LOS B	0.1	0.1	0.57	0.57
All Pedestrians		200	21.4	LOS C			0.70	0.70

Level of Service (LOS) Method: SIDRA Pedestrian LOS Method (Based on Average Delay)
Pedestrian movement LOS values are based on average delay per pedestrian movement.
Intersection LOS value for Pedestrians is based on average delay for all pedestrian movements.

NETWORK SUMMARY

Network: N101 [Existing + Additional Trucks PM]

New Network
Actuated Isolated Cycle Time = 100 seconds (Practical Cycle Time)
Common Control Group: CCG1 [CCGName]

Network Performance - Hourly Values								
Performance Measure	**Vehicles**		**Per Unit Distance**		**Pedestrians**		**Persons**	
Network Level of Service (LOS)	LOS F							
Travel Time Index	1.09							
Speed Efficiency	0.20							
Congestion Coefficient	5.04							
Travel Speed (Average)	11.9	km/h			2.6	km/h	11.8	km/h
Travel Distance (Total)	5976.8	veh-km/h			10.5	ped-km/h	7182.7	pers-km/h
Travel Time (Total)	501.9	veh-h/h			4.0	ped-h/h	606.3	pers-h/h
Desired Speed	60.0	km/h						
Demand Flows (Total for all Sites)	10488	veh/h			350	ped/h	12586	pers/h
Arrival Flows (Total for all Sites)	10306	veh/h			350	ped/h	12367	pers/h
Percent Heavy Vehicles (Demand)	5.4	%						
Percent Heavy Vehicles (Arrival)	5.5	%						
Degree of Saturation	1.380							
Control Delay (Total)	401.87	veh-h/h			1.72	ped-h/h	483.97	pers-h/h
Control Delay (Average)	140.4	sec			17.7	sec	140.9	sec
Control Delay (Worst Lane)	751.9	sec						
Control Delay (Worst Movement)	751.9	sec			29.7	sec	751.9	sec
Geometric Delay (Average)	1.2	sec						
Stop-Line Delay (Average)	139.2	sec						
Queue Storage Ratio (Worst Lane)	1.00							
Total Effective Stops	13402	veh/h			242	ped/h	16325	pers/h
Effective Stop Rate	1.30	per veh	2.2	per km	0.69	per ped	1.32	per pers
Proportion Queued	0.83				0.69		0.86	
Performance Index	1019.6				5.3		1024.9	
Cost (Total)	17183.26	$/h	2.87	$/km	99.78	$/h	17283.04	$/h
Fuel Consumption (Total)	1294.3	L/h	216.6	mL/km				
Fuel Economy	21.7	L/100km						
Carbon Dioxide (Total)	3073.4	kg/h	514.2	g/km				
Hydrocarbons (Total)	0.351	kg/h	0.059	g/km				
Carbon Monoxide (Total)	3.043	kg/h	0.509	g/km				
NOx (Total)	5.999	kg/h	1.004	g/km				

Network Model Accuracy Level (largest change in degree of saturation for any lane): 2.5 %
Number of Iterations: 10 (maximum specified: 10)
Network Level of Service (LOS) Method: SIDRA Speed Efficiency.
Setup used: New South Wales.

Network Performance - Annual Values						
Performance Measure	**Vehicles**		**Pedestrians**		**Persons**	
Demand Flows (Total for all Sites)	5,034,240	veh/y	168,000	ped/y	6,041,089	pers/y
Delay	192,898	veh-h/y	827	ped-h/y	232,305	pers-h/y
Effective Stops	6,433,147	veh/y	116,162	ped/y	7,835,938	pers/y
Travel Distance	2,868,881	veh-km/y	5,026	ped-km/y	3,447,684	pers-km/y
Travel Time	240,922	veh-h/y	1,901	ped-h/y	291,007	pers-h/y
Cost	8,247,966	$/y	47,895	$/y	8,295,861	$/y
Fuel Consumption	621,262	L/y				
Carbon Dioxide	1,475,222	kg/y				
Hydrocarbons	169	kg/y				
Carbon Monoxide	1,460	kg/y				

NOx	2,879 kg/y

MOVEMENT SUMMARY

Site: 101 [Existing AM]

Five Islands Rd / Flinders St
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Five Islands Rd											
5	T1	2303	4.1	0.544	4.2	LOS A	11.2	81.5	0.47	0.43	73.3
3	R2	30	13.3	0.103	23.5	LOS B	0.6	5.0	0.87	0.71	46.6
Approach		2333	4.2	0.544	4.4	LOS A	11.2	81.5	0.47	0.43	72.8
East: Flinders St											
4	L2	30	46.7	0.381	28.1	LOS B	1.8	14.8	0.95	0.79	37.8
6	R2	101	52.5	0.570	36.2	LOS C	2.0	25.9	0.98	0.80	34.3
Approach		131	51.1	0.570	34.4	LOS C	2.0	25.9	0.97	0.80	34.9
North: Five Islands Rd											
7	L2	154	32.5	0.752	27.7	LOS B	16.4	126.9	0.91	0.87	47.4
11	T1	1529	4.8	0.752	20.9	LOS B	17.7	129.3	0.92	0.85	54.5
Approach		1683	7.4	0.752	21.5	LOS B	17.7	129.3	0.92	0.85	53.8
All Vehicles		4147	7.0	0.752	12.3	LOS A	17.7	129.3	0.67	0.61	61.8

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Existing PM]

Five Islands Rd / Flinders St
Signals - Fixed Time Isolated Cycle Time = 80 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Five Islands Rd											
5	T1	1985	1.8	0.443	3.3	LOS A	8.7	62.1	0.37	0.34	74.6
3	R2	24	0.0	0.086	27.6	LOS B	0.6	4.4	0.89	0.70	44.5
Approach		2009	1.8	0.443	3.6	LOS A	8.7	62.1	0.38	0.34	74.0
East: Flinders St											
4	L2	31	12.9	0.670	47.3	LOS D	4.0	29.0	1.00	0.90	34.2
6	R2	144	31.3	0.670	48.8	LOS D	4.0	29.0	1.00	0.88	28.9
Approach		175	28.0	0.670	48.5	LOS D	4.0	30.4	1.00	0.88	29.7
North: Five Islands Rd											
7	L2	84	47.6	0.807	30.7	LOS C	25.6	191.1	0.92	0.89	45.9
11	T1	2099	2.3	0.807	22.5	LOS B	26.6	190.2	0.92	0.88	53.4
Approach		2183	4.1	0.807	22.8	LOS B	26.6	191.1	0.92	0.88	53.1
All Vehicles		4367	4.0	0.807	15.0	LOS B	26.6	191.1	0.67	0.63	58.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Existing + Additional Trucks AM]

Five Islands Rd / Flinders St
Signals - Fixed Time Isolated Cycle Time = 70 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Five Islands Rd											
5	T1	2303	4.1	0.555	4.6	LOS A	11.9	86.1	0.49	0.45	72.6
3	R2	45	42.2	0.288	26.0	LOS B	1.0	13.8	0.93	0.74	44.3
Approach		2348	4.9	0.555	5.0	LOS A	11.9	86.1	0.50	0.45	71.7
East: Flinders St											
4	L2	45	64.4	0.447	24.1	LOS B	2.2	23.3	0.92	0.79	37.0
6	R2	116	58.6	0.791	38.2	LOS C	2.8	43.8	0.97	0.92	33.8
Approach		161	60.2	0.791	34.2	LOS C	2.8	43.8	0.95	0.88	34.3
North: Five Islands Rd											
7	L2	169	38.5	0.803	31.7	LOS C	17.5	144.5	0.95	0.94	44.8
11	T1	1529	4.8	0.803	24.5	LOS B	20.0	145.5	0.95	0.92	51.8
Approach		1698	8.2	0.803	25.2	LOS B	20.0	145.5	0.95	0.92	51.0
All Vehicles		4207	8.3	0.803	14.3	LOS A	20.0	145.5	0.70	0.66	59.5

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Existing + Additional Trucks PM]

Five Islands Rd / Flinders St
Signals - Fixed Time Isolated Cycle Time = 80 seconds (User-Given Cycle Time)

Movement Performance - Vehicles											
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Five Islands Rd											
5	T1	1985	1.8	0.458	4.0	LOS A	9.7	69.1	0.41	0.37	73.5
3	R2	39	38.5	0.306	30.6	LOS C	1.1	15.0	0.95	0.73	42.0
Approach		2024	2.5	0.458	4.6	LOS A	9.7	69.1	0.42	0.38	72.4
East: Flinders St											
4	L2	46	41.3	0.751	48.0	LOS D	5.0	46.0	1.00	0.99	31.5
6	R2	159	37.7	0.751	49.6	LOS D	5.0	46.0	1.00	0.97	27.4
Approach		205	38.5	0.751	49.2	LOS D	5.0	46.0	1.00	0.97	28.2
North: Five Islands Rd											
7	L2	99	55.6	0.874	40.6	LOS C	30.0	236.2	0.97	1.03	40.6
11	T1	2099	2.3	0.874	31.5	LOS C	32.6	232.7	0.98	1.01	47.3
Approach		2198	4.7	0.874	31.9	LOS C	32.6	236.2	0.98	1.02	46.9
All Vehicles		4427	5.3	0.874	20.2	LOS B	32.6	236.2	0.72	0.72	53.9

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Intersection and Approach LOS values are based on average delay for all vehicle movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Existing AM]

Old Port Rd / Site Access
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Port Rd											
1	L2	1	0.0	0.055	5.6	LOS A	0.0	0.0	0.00	0.01	58.2
2	T1	85	37.6	0.055	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		86	37.2	0.055	0.1	NA	0.0	0.0	0.00	0.01	59.9
North: Old Port Rd											
8	T1	114	35.1	0.075	0.0	LOS A	0.0	0.3	0.02	0.02	59.8
9	R2	4	50.0	0.075	6.5	LOS A	0.0	0.3	0.02	0.02	30.5
Approach		118	35.6	0.075	0.2	NA	0.0	0.3	0.02	0.02	57.9
West: Bis Industries Access											
10	L2	7	71.4	0.010	6.5	LOS A	0.0	0.4	0.23	0.99	27.6
12	R2	2	0.0	0.010	5.1	LOS A	0.0	0.4	0.23	0.99	28.3
Approach		9	55.6	0.010	6.2	LOS A	0.0	0.4	0.23	0.99	27.7
All Vehicles		213	37.1	0.075	0.4	NA	0.0	0.4	0.02	0.06	56.1

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Existing PM]

Old Port Rd / Site Access
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Port Rd											
1	L2	1	0.0	0.035	5.6	LOS A	0.0	0.0	0.00	0.01	58.2
2	T1	57	29.8	0.035	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		58	29.3	0.035	0.1	NA	0.0	0.0	0.00	0.01	59.8
North: Old Port Rd											
8	T1	60	28.3	0.037	0.0	LOS A	0.0	0.1	0.01	0.01	59.9
9	R2	1	0.0	0.037	5.6	LOS A	0.0	0.1	0.01	0.01	30.6
Approach		61	27.9	0.037	0.1	NA	0.0	0.1	0.01	0.01	58.9
West: Bis Industries Access											
10	L2	3	0.0	0.003	4.3	LOS A	0.0	0.1	0.15	0.89	28.4
12	R2	1	0.0	0.003	4.6	LOS A	0.0	0.1	0.15	0.89	28.3
Approach		4	0.0	0.003	4.4	LOS A	0.0	0.1	0.15	0.89	28.4
All Vehicles		123	27.6	0.037	0.2	NA	0.0	0.1	0.01	0.04	57.3

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Existing + Additional Trucks AM]

Old Port Rd / Site Access
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Port Rd											
1	L2	1	0.0	0.055	5.6	LOS A	0.0	0.0	0.00	0.01	58.2
2	T1	85	37.6	0.055	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		86	37.2	0.055	0.1	NA	0.0	0.0	0.00	0.01	59.9
North: Old Port Rd											
8	T1	114	35.1	0.155	1.0	LOS A	0.7	8.9	0.23	0.18	57.6
9a	R1	29	100.0	0.155	7.3	LOS A	0.7	8.9	0.23	0.18	54.3
9	R2	4	50.0	0.155	6.7	LOS A	0.7	8.9	0.23	0.18	30.0
Approach		147	48.3	0.155	3.0	NA	0.7	8.9	0.23	0.18	55.5
West: Bis Industries Access											
10	L2	7	71.4	0.010	6.5	LOS A	0.0	0.4	0.24	1.00	27.5
12	R2	2	0.0	0.010	6.0	LOS A	0.0	0.4	0.24	1.00	28.2
Approach		9	55.6	0.010	6.4	LOS A	0.0	0.4	0.24	1.00	27.7
SouthWest: Site Access											
30a	L1	29	100.0	0.067	14.3	LOS A	0.3	6.7	0.37	1.11	47.7
Approach		29	100.0	0.067	14.3	LOS A	0.3	6.7	0.37	1.11	47.7
All Vehicles		271	50.6	0.155	3.1	NA	0.7	8.9	0.17	0.25	54.0

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

MOVEMENT SUMMARY

Site: 101 [Existing + Additional Trucks PM]

Old Port Rd / Site Access
Stop (Two-Way)

Movement Performance - Vehicles												
Mov ID	OD Mov	Demand Flows Total veh/h	HV %	Deg. Satn v/c	Average Delay sec	Level of Service	95% Back of Queue Vehicles veh	Distance m	Prop. Queued	Effective Stop Rate per veh	Average Speed km/h
South: Old Port Rd											
1	L2	1	0.0	0.035	5.6	LOS A	0.0	0.0	0.00	0.01	58.2
2	T1	57	29.8	0.035	0.0	LOS A	0.0	0.0	0.00	0.01	59.9
Approach		58	29.3	0.035	0.1	NA	0.0	0.0	0.00	0.01	59.8
North: Old Port Rd											
8	T1	60	28.3	0.109	0.9	LOS A	0.5	7.5	0.23	0.24	57.3
9a	R1	29	100.0	0.109	6.4	LOS A	0.5	7.5	0.23	0.24	53.9
9	R2	1	0.0	0.109	5.7	LOS A	0.5	7.5	0.23	0.24	30.0
Approach		90	51.1	0.109	3.5	NA	0.5	7.5	0.23	0.24	55.6
West: Bis Industries Access											
10	L2	3	0.0	0.003	4.3	LOS A	0.0	0.1	0.16	0.89	28.4
12	R2	1	0.0	0.003	5.2	LOS A	0.0	0.1	0.16	0.89	28.3
Approach		4	0.0	0.003	4.5	LOS A	0.0	0.1	0.16	0.89	28.4
SouthWest: Site Access											
30a	L1	29	100.0	0.059	13.0	LOS A	0.2	6.0	0.28	1.14	48.4
Approach		29	100.0	0.059	13.0	LOS A	0.2	6.0	0.28	1.14	48.4
All Vehicles		181	50.8	0.109	3.6	NA	0.5	7.5	0.16	0.33	54.4

Site Level of Service (LOS) Method: Delay (RTA NSW). Site LOS Method is specified in the Parameter Settings dialog (Site tab).
Vehicle movement LOS values are based on average delay per movement.
Minor Road Approach LOS values are based on average delay for all vehicle movements.
NA: Intersection LOS and Major Road Approach LOS values are Not Applicable for two-way sign control since the average delay is not a good LOS measure due to zero delays associated with major road movements.
SIDRA Standard Delay Model is used. Control Delay includes Geometric Delay.
Gap-Acceptance Capacity: SIDRA Standard (Akçelik M3D).
HV (%) values are calculated for All Movement Classes of All Heavy Vehicle Model Designation.

Appendix 4 – Noise and Vibration Assessment

Spoil Management Pathway Chullora Rail Yard– Noise and Vibration Assessment

Document Control Number: ACO-NW-001-21681B

Date: 19 January 2017

Pacific Environment Limited

Technologies Consulting Monitoring

www.pacific-environment.com

Project Name: Spoil Management Pathway Chullora Rail Yard– Noise and Vibration Assessment

Document Control Number: ACO-NW-001-21681B

Prepared For: Cardno

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Table of contents

List of Figures

List of Tables

1. Introduction

Transport for NSW (TfNSW) is reviewing the viability of transporting spoil from large infrastructure projects within the Sydney Metropolitan Area to the Illawarra Region by train. The Project would involve the transfer of material from sites including the M4 and M5 road projects to the Chullora Rail Yards by truck, where material is subsequently loaded on trains for transport to Port Kembla. It is understood that Cardno is preparing an overarching Review of Environmental Factors (REF) for the Project, with TfNSW the determining authority. This noise and vibration assessment has been prepared to provide supporting documentation for the REF.

1.1 Scope of Work

This report includes an assessment of all construction and operational noise aspects of the Project at Chullora Rail Yard and has been conducted with consideration to the following policies and guidelines:

- Industrial Noise Policy (INP) (EPA, 2000).
- Road Noise Policy (RNP) (DECCW, 2011).
- Interim Construction Noise Guidelines (ICNG) (DECC, 2009).
- Assessing Vibration: A Technical Guideline (DEC, 2006).
- Construction Noise Strategy (TfNSW 2016).

2. Project Description and Local Setting

2.1 Introduction

The Spoil Management Pathway Project (the Project) will establish an integrated transport path for the transfer of Virgin Excavated Natural Material (VENM) from the M4/M5 excavations, to civil construction projects in the Illawarra Region.

The Project will see:

- Outgoing sandstone VENM from the M4/M5 extractions sites transported by road to the Sydney Trains Chullora yard in Sydney.
- The trucks will tip to direct load train wagons.
- Should trains not be in place, a temporary surge pile with a capacity of 3,000 tonnes of material (one train load) is allowed for at Chullora.
- Three 3,000 tonnes (net payload) trains will transport the VENM to Port Kembla. This equates to 9,000 tonnes per day.
- Incoming VENM will be direct transferred from train to truck at the BlueScope Steel CRM yard at Port Kembla.

No materials will be stored at either site (i.e. stockpiled); although some (maximum of one train's worth = 3,000 tonnes) materials may be temporarily deposited during inclement weather or during mechanical maintenance, before being loaded out. Should delays be encountered during the transfer process, material would be held at the M4/M5 excavations and then directed to alternative sites throughout Sydney, ensuring that stockpiling is not required at Chullora or CRM.

The total number of truck movements (one-way) per day into the site will be 255. This will be undertaken in three campaigns per day to coincide with train arrivals, i.e.:

- Early Morning – 85 truck movements
- Lunchtime – 85 truck movements
- Late Afternoon – 85 truck movements

There will likely be 14 trucks in the fleet, working 3 x 3 hours shifts.

A conceptual plant layout is presented in **Figure 2.1** showing the layout of the Project .

Figure 2.1: Concept Site Layout

2.2 Local Setting and Sensitive Receivers

The Chullora Rail Yards site is located off Worth Street, Chullora, NSW. The suburbs around the proposed site include Greenacre to the southeast and Strathfield to the northeast. The nearest residential receivers in the have been grouped into Noise Catchment Areas, presented in **Table 2.1**.

Table 2.1: Noise Catchment Areas

Noise Catchment Area	Suburb	Receiver Types	Distance
A	Strathfield	Residential	400 – 550m
B	Greenacre	Residential	100 – 500m

Figure 2.2 shows the site location, noise catchment areas, receivers and background monitoring locations. The receiver locations presented in **Appendix A** were chosen for the purpose of assessing noise impacts from the Project. These locations are the closest potentially affected receiver locations to the Project.

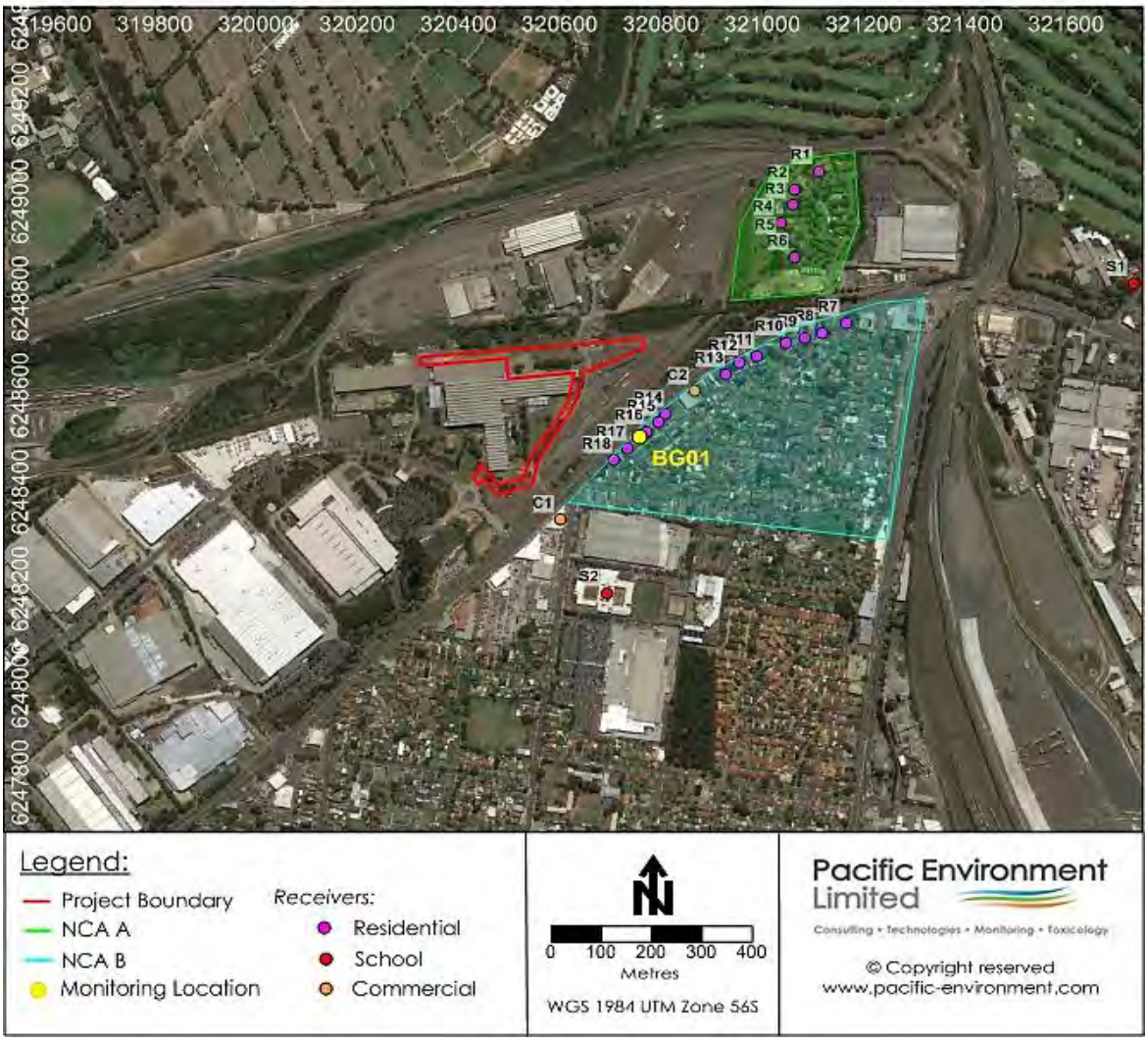


Figure 2.2: Local Setting

2.3 Monitoring Methology

The existing acoustic environment was characterised by a combination of long term and short term noise measurements.

Weather conditions were recorded at Bankstown (066137) and Sydney Olympic Park (066212) automatic weather stations for the duration of monitoring. Where weather conditions unsuitable for noise monitoring occurred, as defined in the INP, the monitoring data was filtered accordingly. Data was also excluded for identified extraneous noise events. Data exclusion is indicated in Appendix B.

The noise levels obtained are expressed in terms of $L_{A10,15min}$, $L_{A90,15min}$ and $L_{Aeq,15min}$.

- $L_{A10,\ 15min}$ is the A-weighted noise level exceeded for 10% of the monitoring period (15 minutes).
- $L_{A90,\ 15min}$ is the A-weighted noise level exceeded for 90% of the monitoring period (15 minutes).
- The $L_{Aeq,\ 15min}$ is the 15 minute equivalent continuous noise level containing the same acoustic energy as the actual fluctuating noise level.

The $L_{A90,\ 15min}$ is commonly referred to as the background noise level and the lowest 10th percentile $L_{A90,15min}$ over a period (day, evening, night) is referred to as the period assessment background level (ABL). The Rating Background Level (RBL) for each day, evening and night period of the monitoring occurrence is then calculated from the ABLs.

2.4 Unattended Monitoring

Unattended background noise monitoring was completed at location BG01, as shown in **Figure 2.2** for the period 22nd November and 2nd December 2016. The noise logger was set to record A-weighted noise levels every 15 minutes and set to 'fast' response time. Calibration was checked before and after each measurement with no significant drift observed.

Table 2.2 provides a summary of the noise monitoring data from this location. Daily graphs for the noise monitoring results are included in **Appendix B**.

Table 2.2: Unattended Noise Monitoring Results

Location	NCA	Measured Noise Level, dB(A)								
		Day			Evening			Night		
		L_{10}	RBL	L_{eq}	L_{10}	RBL	L_{eq}	L_{10}	RBL	L_{eq}
BG01	B	74	56	75	72	53	70	75	51	70

2.5 Attended Monitoring

Short term (attended) noise measurements were also carried out at several locations in the vicinity of the Project. Measurements were undertaken over 15 minute intervals using an NTi Audio XL2 Type 1 Sound Level Meter. Field calibration was checked before and after each measurement occasion with no significant drift (±0.5 dB) observed.

Table 2.3 provides a summary of the attended noise measurements completed on 29th/30th November and 5th December 2016. The weather conditions on and 29th November were clear with light to medium winds and on the 5th December conditions were cloudy with light winds.

Table 2.3: Attended Noise Measurement Results

Date and Time	Location	Measured Noise Level dB(A)				Comments
		$L_{A1,15min}$	$L_{A10,15min}$	$L_{A90,15min}$	$L_{Aeq,15min}$	
				NCA A		
29/11/216 19:00	11 Marlene Crescent	65	59	48	55	Background noise environment consists of distant traffic from the A3, Hume Hwy.
29/11/2016 23:00	11 Marlene Crescent	66	60	40	54	Background noise environment consists of distant traffic from the A3, Hume Hwy.
05/12/2016 10:18	11 Marlene Crescent	53	48	44	47	Background noise environment consists of distant traffic from the A3, Hume Hwy.
				NCA B		
29/11/2016 19:25	7 Robinson St	62	56	46	53	Background noise environment consists of traffic from Hume Highway. No noise from industry. Car passes with peaks 53-60. Motor bike pass with peak 76. Background noise included distant traffic 46-48.
29/11/2016 19:50	4 Wesley St	70	65	51	61	Background noise environment consists of traffic from Hume Highway. No noise from industry. Motor bike pass with peak 77. Background noise included distant traffic
30/11/2016 0:17	4 Wesley St	71	64	42	60	Background noise environment consists of traffic from Hume Highway. No noise from industry. Background noise included distant traffic
30/11/2016 0:50	7 Robinson St	70	65	42	60	Background noise environment consists of traffic from Hume Highway. No noise from industry. Background noise included distant traffic.
5/12/2016 9:59	4 Wesley St	80	77	61	73	Background noise environment consists of traffic from Hume Highway. Truck passes with peaks 77-88.
5/12/2016 10:18	7 Robinson St	80	77	63	73	Background noise environment consisted of traffic from Hume Highway. Car passes with constant 76. Track passes with peaks 82. Background noise included distant traffic 46-48.

Note: All levels in dB(A).

2.6 Discussion of Results

Noise monitoring indicated an urban noise environment influenced by traffic noise sources at each of the monitoring locations. Noise levels followed typical diurnal patterns with increased levels of traffic and community noise influence during the day time hours and lower ambient noise levels during the night time hours. Traffic noise was the primary influence on the L_{Aeq} noise descriptor. Industrial and fauna noise were almost inaudible at the logging locations in the background due to traffic.

2.7 Meteorological Conditions

Noise enhancing winds was assessed assuming source to receiver (west, north west and northerly) winds are potential features of the Chullora area.

The region has also been identified as an area often affected by temperature inversions. A moderate inversion has been considered as part of this assessment.

3. Assessment Criteria

3.1 Operational Noise

Operational noise is assessed according to the INP (**EPA, 2000**). The criteria set in the INP are non-mandatory, however it is emphasised that all reasonable and feasible measures should be implemented in an attempt to achieve the criteria. Where the criteria are not met, additional considerations may apply. The criteria considered are the intrusive and amenity noise criteria.

Intrusiveness Noise Criteria

Defined as the $L_{Aeq,15min}$ noise level within the day (7am to 6pm Monday to Saturday, 8 am to 6pm Sundays and Public Holidays), evening (6pm to 10pm) or night time (10pm to 7am, 10pm to 8am Sundays and Public Holidays) assessment periods should not exceed the Rating Background Level[1] (RBL) within that period by more than 5 dB(A).

Intrusiveness criteria have been defined for two areas based on background noise monitoring completed for the Project. Unattended monitoring data from BG01 has been used to determine the criteria for receivers affected by traffic noise (NCA B). Short term attended measurements from Marlene Crescent have been used to determine the criteria for receivers less affected by traffic (NCA A). The results are presented in **Table 3.1**.

Table 3.1: Intrusiveness criteria

Receiver/Land Use	Descriptor	Intrusiveness Criteria, dB(A)[1]		
		Day	Evening	Night
Residential (**NCA A**)[1]	$L_{Aeq,15min}$	49	49[2]	45
Residential (**NCA B**)[3]	$L_{Aeq,15min}$	61	58	56

Note: 1. Sourced from measurements at Marlene Crescent (Section 2.5).

2. Daytime RBL was adopted for the evening period, as the evening period RBL cannot be less than the daytime RBL, in accordance with the INP application notes.

3. Sourced from unattended measurements at BG01 (Section 2.4).

Amenity Noise Criteria

Defined as the maximum ambient L_{Aeq} noise level from industrial sources within the day, evening and night assessment period should not exceed the "acceptable noise levels" (ANL) published in the INP and reproduced in **Table 3.2.**

The ANL is dependent on the relevant receiver type and area category for the residential receiver. The purpose of this noise goal is to provide an upper limit to industry related noise emission and prevent industrial noise from creeping higher with each new successive industrial development.

Noise monitoring indicated both catchment areas were influenced by nearby and distant traffic. Each of the monitoring locations was considered as having an 'urban hum'. These descriptions of the background levels are consistent with the description applied to urban environments in the INP. For this assessment, residential receivers in NCA A and NCA B were considered Urban.

[1] The overall single figure background level representing each assessment period (day/evening/night) over the whole monitoring period.

Table 3.2: Amenity criteria, recommended L_{Aeq} levels from industrial noise sources

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level dB(A)	
			Acceptable	Recommended Maximum
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
School Classroom – internal	All	Noisiest 1-hour period when in use	35	40
Places of Worship - internal	All	When in use	40	45
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

Note: This table is a reproduction of Table 2.1 of the INP. It should be read in conjunction with the notes from Section 2.2.1 of the INP.

The level of transportation noise—road traffic noise in particular—may be high enough to make noise from an industrial source effectively inaudible, even though the L_{Aeq} noise level from that industrial noise source may exceed the recommended acceptable noise level shown in **Table 3.2**. In such cases, the amenity criterion for noise from the industrial noise becomes the L_{Aeq}, period (traffic) minus 10 dB.

Noise monitoring indicated that noise in NCA B was highly traffic affected, therefore the traffic affected ANL has been applied. Noise levels in NCA A were affected by distant traffic, but are not considered heavily traffic affected, therefore the ANLs for urban areas are unchanged for receivers in this area. ANLs are presented in **Table 3.3**.

Table 3.3: Amenity criteria – Residential Urban L_{Aeq} levels from industrial noise sources

Receiver/Land Use	Descriptor	Operational Noise Criteria, dB(A)[1]		
		Day	Evening	Night
Residential (NCA A)	$L_{Aeq,period}$	60	55	45
Residential (NCA B)[1]	$L_{Aeq,period}$	65	60	60

Note: 1. $L_{Aeq,period}$ (traffic) minus 10 dB

Project Specific Noise Levels

The project specific noise levels (PSNL) for the Project are presented in **Table 3.4** based on the more stringent of the intrusiveness and amenity criteria, as required by the INP. The intrusiveness criteria were found to be the more stringent criteria applicable for residential receivers.

Table 3.4: Project Specific Noise Levels

Receiver/Land Use	Descriptor	Operational Noise Criteria, dB(A)[1]		
		Day	Evening	Night
Residential (**NCA A**)	$L_{Aeq,15min}$	49	49	45
Residential (**NCA B**)	$L_{Aeq,15min}$	61	58	56
School Classroom– external (when in use)	$L_{Aeq,15min}$	45	45	45
Commercial premises	$L_{Aeq,period}$	65	65	65

3.2 Low Frequency Noise

The characteristics of a noise source can increase annoyance for sensitive receivers. Examples of annoying characteristics are: prominent tones, impulsiveness, intermittent sources and low frequency noise. The INP provides guidance on 'modifying factors' which should be applied to predicted or measured noise levels when a dominant low frequency[2] noise characteristic is present. Table 4.1 of the INP states that low frequency noise is considered dominant where the difference between the A-weighted and C-weighted noise levels is 15 dB or greater. Where this difference occurs, the INP recommends a modifying factor of 5 dB is added to the predicted noise level.

3.3 Sleep Disturbance

There are currently no universally accepted criteria applicable to protection from sleep disturbance. That is, at the current level of understanding, it is not possible to establish absolute noise level goals that would correlate to levels of sleep disturbance for all, or even a majority of people. However, sleep disturbance from noise is recognised by the World Health Organisation (WHO) as having the potential to adversely affect the health and wellbeing of people and it is the subject of ongoing research.

The WHO Guidelines for Community Noise (1999) provides guidance on sleep disturbance effects from noise. It states that where the noise is not continuous, the maximum A weighted noise level or L_{Amax} can be used to indicate the probability of noise-induced awakenings. It states that:

> "Effects have been observed at individual L_{Amax} exposures of 45 dB or less."

Furthermore, it states that the guidelines should be based on the combination of values of the ambient L_{Aeq} noise and the L_{Amax}. The WHO guideline external value for sleep disturbance is L_{Amax} 60 dB(A). This value is an external level, based upon the assumed outside to inside correction of 15 dB assuming windows are open. However it has been noted that the outside to inside correction has been observed to vary between 5-15 dB[3] where windows are open to windows partially closed. Therefore in order to provide a conservative approach, a value of L_{Amax} 55 dB(A) has been used.

As the existing background noise levels at receivers adjacent the Hume Highway are already elevated with L_{Aeq} traffic noise levels of approximately 70 dB(A) during the night time period, this screening criteria is considered conservative.

3.4 Construction Noise

The ICNG provides noise management levels for the control of noise from construction. In general these criteria are that construction noise should not exceed the background noise level by more than 10 dB(A) during standard hours, and by more than 5 dB(A) outside of standard hours. The criteria for residential receivers for this Project are given in **Table 3.5.**

[2] Contains the major components within the low frequency range (20 Hz – 250 Hz) of the frequency spectrum.

[3] Outside to Inside correction as documented in the following publications: Queensland Department of Environment and Heritage Protection EcoAccess Guideline Planning for Noise Control, NSW Environmental Criteria for Road Traffic Noise, NSW RTA Environmental Noise Management Manual and WHO Guidelines for Community Noise.

A number of activities have proven to be particularly annoying to nearby residents:

- use of 'beeper' style reversing or movement alarms, particularly at night-time
- use of power saws, such as used for cutting timber, rail lines, masonry, road pavement or
- steel work
- grinding metal, concrete or masonry
- rock drilling
- line drilling
- vibratory rolling
- rail tamping and regulating
- bitumen milling or profiling
- jackhammering, rock hammering or rock breaking
- Impact piling.

If any of these activities are to be undertaken they should be factored into the quantitative assessment by adding 5 dB to the predicted levels.

Table 3.5: Construction Noise Management Levels at Private Residences

Time of Day	Management Level $L_{Aeq,15min}$	How to Apply
Recommended Standard Hours: Monday to Friday 7am to 6pm Saturday 8am to 1pm No work on Sundays or Public Holidays	Noise affected RBL + 10dB(A)	The noise affected level represents the point above which there may be some community reaction to noise. ▪ Where the predicted or measured $L_{Aeq,(15min)}$ is greater than the noise affected level, the proponent should apply all feasible and reasonable work practices to meet the noise affected level. ▪ The proponent should also inform all potentially impacted residents of the nature of works to be carried out, the expected noise levels and duration, as well as contact details.
	Highly noise affected 75dB(A)	The highly noise affected level represents the point above which there may be strong community reaction to noise. ▪ Where noise is above this level, the relevant authority (consent, determining or regulatory) may require respite periods by restricting the hours that the very noisy activities can occur, taking into account: 1. Times identified by the community when they are less sensitive to noise (such as before and after school for works near schools, or mid-morning or mid-afternoon for works near residences 2. If the community is prepared to accept a longer period of construction in exchange for restrictions on construction times.
Outside recommended standard hours	Noise affected RBL + 5dBA	▪ A strong justification would typically be required for works outside the recommended standard hours ▪ The proponent should apply all feasible and reasonable work practices to meet the noise affected level. ▪ Where all feasible and reasonable practices have been applied and noise is more than 5 dB(A) above the noise affected level, the proponent should negotiate with the community.

A summary of the Project specific construction noise management levels for residential receivers and other receiver types is presented in Table 3.6. The unattended measured background noise levels summarised in **Section 2.4** has been used for residential receivers.

Table 3.6: Project Specific Construction Noise Management Level, $L_{Aeq,15min}$ dB(A)

Land Use	Standard Hours Monday to Friday 7am to 6pm Saturday 8am to 1pm
Residential (NCA A)	54
Residential (NCA B)	66
Classrooms at Schools and other Educational Institutions[1]	50
Commercial	70

Notes: 1. External noise level based on an outside to inside correction of 10 dB(A), in accordance with the INP.

3.5 Vibration

Impacts from vibration can be considered both in terms of effects on building occupants (human comfort) and the effects on the building structure (building damage). Of these considerations, the human comfort limits are the most stringent. Therefore, for occupied buildings, if compliance with human comfort limits is achieved, it will follow that compliance will be achieved with the building damage objectives.

3.5.1 Human Comfort

The EPA administered guideline entitled "*Assessing Vibration: A Technical Guideline,"* which provides acceptable values for continuous and impulsive vibration in the range 1-80Hz.

Where vibration is intermittent, such as for construction sources, a vibration dose is calculated and acceptable values are shown in **Table 3.7** below.

Table 3.7: Acceptable Vibration Dose Values for Intermittent Vibration

Location	Daytime[1] ($m/s^{1.75}$)		Night Time[1] ($m/s^{1.75}$)	
	Preferred Value	Maximum Values	Preferred Value	Maximum Value
Critical areas [2]	0.10	0.20	0.10	0.20
Residences	0.20	0.40	0.13	0.26
Offices, schools, educational institutions and places of worship	0.40	0.80	0.40	0.80
Workshops	0.80	1.60	0.80	1.60

Notes: 1 Daytime is 7.00am to 10.00pm and night time is 10.00pm to 7.00am.
2 Examples include hospital operating theatres and precision laboratories where sensitive operations are occurring. These criteria are only indicative, and there may be a need to assess intermittent values against the continuous or impulsive criteria for critical areas. Source BS 6472-1992.

3.5.2 Building Damage

German Standard *DIN 4150-3-1999 "Structural Vibration – Part 3 Effects of vibration on structures"* provides methods for evaluating the effects of vibration on structures in the absence of an Australian Standard.

The recommended limits (guide values) from DIN 4150 for transient vibration to ensure minimal risk of cosmetic damage to residential and industrial buildings are presented numerically in **Table 3.8**.

Table 3.8: Guideline Vibration Values for Short Term Vibration on Structures (mm/s)

Type of Building	Guideline values for velocity (mm/s)			
	1 to 10 Hz	10 to 50 Hz	50 to 100 Hz	Vibration at horizontal plane of highest floor at all frequencies
Commercial and Industrial Building	20	20-40	40-50	40
Dwellings and buildings of similar occupancy or design	5	5-15	15-20	15
Structures that, because of their particular sensitivity to vibration cannot be classified under lines 1 and 2 and are of great intrinsic value	3	3-8	8-10	8

3.6 Road Traffic Noise

At existing residences and other sensitive land uses affected by additional traffic on existing roads generated by land use developments, the RNP states that any increase in the total traffic level should be limited to 2 dB above the road traffic noise level without the development. The RNP application notes states that this limit should be applied wherever the noise level without the development is within 2 dB of or exceeds the noise assessment criterion.

4. Operational Noise Assessment

4.1 Modelling Methodology

Noise modelling has been undertaken using CONCAWE's *Special Task Forces in Noise Propagation* (CONCAWE, 1981) algorithms, as implemented within the CadnaA 4.5 acoustic modelling package. The noise modelling takes into consideration the sound power level of the proposed site operations, activities and equipment, and applies adjustments for attenuation from geometric spreading, acoustic shielding from intervening ground topography, ground effect, meteorological effects and atmospheric absorption.

4.2 Modelling Scenarios

The modelling has assumed a conservative 15 minute scenario representative of the proposed operations. Based on preliminary modelling a number of scenarios have been developed to represent typical operational activities.

- Scenario 1: Train Loading including material delivery via truck
- Scenario 2: Spoil delivery only excluding train loading.

During train loading operations the primary noise sources are the locomotives, to represent unloading operations it has been assumed that 50% of a typical assessment period the locomotives are idling and 50% of the time the locomotives moving at low speed.

4.3 Meteorological Conditions

Table 4.1 presents the meteorological conditions included in the assessment. Noise enhancing weather conditions are represented by gradient wind flows and inversion conditions.

Table 4.1: Meteorological Modelling Conditions

ID	Period	Meteorological Conditions	Modelling Parameters			
			Wind	Pasquil-Gifford Stability Class	Relative Humidity	Air Temperature
1	Day	Neutral	No Wind	D	70%	20°C
2	Day	Gradient Wind	3 m/s NW	D	70%	20°C
3	Day	Gradient Wind	3 m/s N	D	70%	20°C
4	Day	Gradient Wind	3 m/s W	D	70%	20°C
5	Evening/Night	Neutral	No Wind	D	90%	10°C
6	Evening/Night	Gradient Wind	3 m/s NW	D	90%	10°C
7	Evening/Night	Gradient Wind	3 m/s N	D	90%	10°C
8	Evening/Night	Gradient Wind	3 m/s W	D	90%	10°C
9	Evening/Night	Inversion	No wind	F	90%	10°C

4.4 Sound Power Levels

The sound power levels (SWLs) used in the operational noise assessment are presented in **Table 4.2**. The sound power levels are taken from Pacific Environment's noise source database which includes data from the UK DEFRA construction noise database and the British Standard 5228.

During train loading operations the primary noise sources are the locomotives. To represent loading operations it has been assumed that 50% of a typical assessment period the locomotives are idling and 50% of the time the locomotives moving at low speed.

Source locations are indicated in **Appendix C**.

Table 4.2: Modelled Sound Power Levels

Item	Overall SWL dB(A)	Units, Scenario 1	Units, Scenario 2
Trucks on access road	106	7	7
Truck Idling	95	4	4
Dumping spoil	102	1	1
Front end loader	104	1	1
Train locomotive low speed	102	1	-
Train locomotive Idling	100	1	-
Conveyor (line source)	79/m	1	-
Spoil dump to rail wagon	105	1	-
Conveyor drives	98	1	-

4.5 Operational Noise Modelling Results

Predicted noise levels for all receivers are presented in **Table 4.3** for Scenario 1 and **Table 4.4** for Scenario 2. Noise contours are presented in **Appendix D**.

Scenario 1 results indicate potential noise exceedance at the two nearest elevated receivers in NCA A during the night time period by 1 dB. Review of the noise model source contributions indicate that the locomotives are the primary noise source contributing to the noise exceedances. Locomotive operations can also potentially result in an annoying low frequency noise impact which would require a 5 dB penalty as per the INP. Where a low frequency penalty is applied due to locomotive operation during the night time period, noise exceedances would occur for all elevated receivers assessed in NCA A and receiver R13-R18 in NCA B.

Modelling results indicate noise levels from scenario 2 were below the day evening and night time criteria for all residential receivers.

Noise mitigation and management measures are discussed further in **section 8**.

Table 4.3: Predicted Operational Noise – Scenario 1

Receivers ID	Predicted Noise Level $L_{Aeq,15min}$ dB(A)			
	Day		Evening/Night	
	Neutral	Noise Enhancing	Neutral	Noise Enhancing
NCA A				
Amenity Criterion	*60*	*60*	*50/45*	*50/45*
Intrusiveness Criterion	*49*	*49*	*49/45*	*49/45*
R1	34	36	34	37
R2	37	39	37	40
R3	39	41	39	42
R4	37	38	37	38
R5	41	43	41	44
R6	39	41	39	41
R1.1(1)	39	41	39	42
R2.1(1)	41	43	41	44
R3.1(1)	41	43	42	44
R4.1(1)	42	44	42	45
R5.1(1)	43	45	44	46
R6.1(1)	43	45	43	46
NCA B				
Amenity Criterion	*65*	*65*	*60/60*	*60/60*
Intrusiveness Criterion	*61*	*61*	*58/56*	*58/56*
R7	38	40	38	40
R8	39	41	40	42
R9	42	44	42	45
R10	44	46	44	47
R11	47	49	47	49
R12	48	50	48	50
R13	49	51	50	52
R14	53	54	53	55
R15	53	54	53	55
R16	53	54	53	55
R17	52	54	53	55
R18	51	53	52	54
Schools				
Amenity Criterion	*45*	*45*	*45*	*45*
S1	21	23	21	23
S2	36	39	36	40
Commercials				
Amenity Criterion	*65*	*65*	*65*	*65*
C1	52	54	53	54
C2	49	50	49	50

Note: (1) Third floor of the receiver.

Night time exceedances shaded grey.

Table 4.4: Predicted Operational Noise – Scenario 2

Receivers ID	Predicted Noise Level $L_{Aeq,15min}$ dB(A)			
	Day		Evening/Night	
	Neutral	Noise Enhancing	Neutral	Noise Enhancing
NCA A				
Amenity Criterion	*60*	*60*	*50/45*	*50/45*
Intrusiveness Criterion	*49*	*49*	*49/45*	*49/45*
R1	26	29	26	31
R2	30	34	31	35
R3	33	36	33	38
R4	26	29	26	30
R5	34	38	35	39
R6	31	35	32	36
R1.1	33	37	33	38
R2.1	35	39	36	40
R3.1	36	40	37	41
R4.1	36	40	36	41
R5.1	37	41	38	42
R6.1	37	41	37	41
NCA B				
Amenity Criterion	*65*	*65*	*60/60*	*60/60*
Intrusiveness Criterion	*61*	*61*	*58/56*	*58/56*
R7	31	35	32	36
R8	33	36	34	38
R9	37	40	37	41
R10	39	42	39	44
R11	41	45	42	46
R12	42	46	43	47
R13	43	46	44	47
R14	47	50	48	51
R15	48	50	48	51
R16	49	51	49	52
R17	50	52	50	53
R18	50	52	50	53
Schools				
Amenity Criterion	*45*	*45*	*45*	*45*
S1	11	15	11	16
S2	35	38	35	39
Commercial				
Amenity Criterion	*65*	*65*	*65*	*65*
C1	52	53	52	54
C2	41	44	41	45

Note: (1) Third floor of the receiver.

4.6 Sleep Disturbance

Sleep disturbance events have the potential to be caused by short high level noise events from operations. These can be caused by a number of activities and equipment items including trucks being loaded, engine start-ups and revving, tonal reversing alarms, warning and system alarms.

A conservative noise level of L_{Amax} 120 dB(A) has been assumed to represent typical maximum noise level events from a truck air break release or similar peak noise events.

The predicted maximum noise level results at residential receivers are presented in **Table 4.5** and **Table 4.6**.

Table 4.5: Predicted L_{Amax} Noise Levels Scenario 1

Receivers ID	Predicted Noise Level L_{Amax}dB(A) Evening/Night	
	Neutral	Noise Enhancing
Criteria L_{Amax},	*55*	*55*
NCA A		
R1	39	43
R2	43	47
R3	47	51
R4	40	43
R5	49	53
R6	46	49
R1.1	47	51
R2.1	48	52
R3.1	49	53
R4.1	50	54
R5.1	50	54
R6.1	50	54
NCA B		
R7	44	48
R8	46	50
R9	50	53
R10	52	55
R11	54	57
R12	55	58
R13	56	59
R14	60	63
R15	60	63
R16	60	63
R17	59	63
R18	52	54

Notes: results exceeding the screening criteria are shaded grey.

Table 4.6: Predicted L_{Amax} Noise Levels Scenario 2

Receivers ID	Predicted Noise Level L_{Amax}dB(A) Evening/Night	
	Neutral	Noise Enhancing
Criteria L_{Amax},	*55*	*55*
NCA A		
R1	38	42
R2	42	47
R3	46	50
R4	37	41
R5	48	52
R6	45	49
R1.1	47	51
R2.1	48	52
R3.1	48	53
R4.1	49	53
R5.1	50	54
R6.1	49	54
NCA B		
R7	43	47
R8	45	49
R9	49	53
R10	51	55
R11	53	57
R12	54	58
R13	55	59
R14	59	62
R15	59	62
R16	59	63
R17	59	62
R18	51	54

Notes: results exceeding the screening criteria are shaded grey.

Maximum noise levels are predicted to exceed relevant sleep disturbance criteria at the nearest residential receivers in NCA B for both assessment scenarios, however as the L_{Aeq} average ambient noise level are already significantly higher, the sleep disturbance is considered low risk at these locations. Noise mitigation measures are discussed further in **section 8**.

4.7 Operational Vibration

Due to the separation distances between the Project area and the nearest sensitive receivers and the nature of the activities, no significant operational vibration impacts are anticipated.

5. Construction Noise Assessment

The duration of the site preparation for the Project is estimated to be three (3) weeks.

Site Preparation Works Required:

- Protection of heritage rail assets – cover with fill
- Signage and Access Improvements – minor works
- Extension of rail line, 2 x 120 m sections
- Delivery of drive-over truck-unloader to site

For noise assessment purposes the construction stages are:

- Scenario 1: Landform, earthworks and clearing
- Scenario 2: Protection of heritage rail assets
- Scenario 3: Extension of rail line

Construction noise levels were predicted for the original construction scenario using the noise model approach described in **Section 4.1**.

5.1 Modelling Scenarios

Table 5.1 presents a summary of the fleet which has been used in each modelling scenario across the construction phase.

Construction activities will be undertaken between the recommended standard hours: Monday to Friday 7am to 6pm and Saturday 8am to 1pm. No work on Sundays or Public Holidays.

Table 5.1: Construction Scenarios

Construction Fleet	Scenario 1	Scenario 2	Scenario 3
Tree Mulcher	1	-	-
Chain Saw[1]	1	-	-
Excavator	1	1	-
Roller	-	1	-
Crane	1	1	1
Rail dumper	-	-	1
Rail Tamper	-	-	1
Ballast Regulator	-	-	1
Rail Saw[1]	-	-	1
Lorry 4 axle Truck	1	1	1

Note: 1. Activities considered to be annoying to nearby residents (ICNG, 2009).

5.2 Sound Power Levels

Sound power levels for plant used in construction are taken from Pacific Environment measurements, the UK DEFRA construction noise database and the British Standards 5228.

The sound power levels for construction equipment are presented in **Table 5.2.**

Table 5.2: Construction Equipment Sound Power Levels, dB(A)

Construction Fleet	Overall SWL dB(A)	Number
Tree Mulcher	115	1
Chain Saw	115	1
Excavator	104	1
Roller	102	1
Crane	101	1
Rail dumper	103	1
Rail Tamper	118	1
Ballast Regulator	110	1
Rail Saw	113	1
Lorry 4 axle Truck (line)	108	1

5.3 Construction Noise Modelling Results

Table 5.3 shows the noise modelling results for all the receivers in all Noise Catchment Areas. The results show that for all construction scenarios, construction noise levels at the most sensitive receivers will be below noise criteria.

No receivers are predicted to be highly noise affected (noise levels of 75 dB(A) or above) for the construction scenarios modelled.

Construction noise management is discussed further in **section 8**.

Table 5.3: Predicted Construction Noise

Receivers ID	Criteria L_{Aeq},15min dB(A)	Predicted Noise Level $L_{Aeq,15min}$ dB(A)		
		Scenario 1	Scenario 2	Scenario 3
NCA A				
R1	*54*	46	27	35
R2	*54*	50	30	43
R3	*54*	54	33	45
R4	*54*	46	26	40
R5	*54*	55	35	48
R6	*54*	52	32	47
R1.1	*54*	54	32	44
R2.1	*54*	56	35	47
R3.1	*54*	56	36	48
R4.1	*54*	57	36	47
R5.1	*54*	58	38	49
R6.1	*54*	57	37	51
NCA B				
R7	*66*	43	25	39
R8	*66*	52	33	48
R9	*66*	56	36	50
R10	*66*	53	34	48
R11	*66*	60	41	52
R12	*66*	61	42	53
R13	*66*	61	44	54
R14	*66*	60	47	57
R15	*66*	60	47	58
R16	*66*	58	48	59
R17	*66*	59	49	59
R18	*66*	60	50	60
SCHOOLS				
S1	*50*	<25	<25	<25
S2	*50*	46	35	45
COMMERCIALS				
C1	*70*	63	53	63
C2	*70*	60	41	51

6. Construction Vibration

Construction vibration impacts are not expected at residential locations. Short term vibration impacts from excavation and compaction may need to be considered during earthworks for the rail loadout plant.

The Construction Noise and Vibration Guideline (RMS 2016) provides recommended safe working distances for a range of typical vibration generating plant. These are presented in **Table 6.1.**

Table 6.1: Recommended safe working distances for vibration

Plant Item	Rating/Description	Safe Working Distance	
		Cosmetic Damage (BS 7385)	Human Response (OH&E Vibration Guideline)
Vibratory Roller	< 50 kN (Typically 1-2 tonnes)	5 m	15 m to 20 m
	< 100 kN (Typically 2-4 tonnes)	6 m	20 m
	< 200 kN (Typically 4-6 tonnes)	12 m	40 m
	< 300 kN (Typically 7-13 tonnes)	15 m	100 m
Small Hydraulic Hammer	(300 kg - 5 to 12t excavator)	2 m	7 m
Medium Hydraulic Hammer	(900 kg – 12 to 18t excavator)	7 m	23 m
Large Hydraulic Hammer	(1600 kg – 18 to 34t excavator)	22 m	73 m
Vibratory Pile Driver	Sheet piles	2 m to 20 m	20 m
Pile Boring	≤ 800 mm	2 m (nominal)	N/A
Jackhammer	Hand held	1 m (nominal)	Avoid contact with structure

Based on the above information, it is anticipated that the construction works can occur up to 5 m from buildings and comply with safe working distances for sensitive receivers.

7. Road Traffic Noise

The Project is expected to generate additional traffic on the Hume Highway.

7.1 Project Generated Traffic

During operation, the Project is expected to generate heavy vehicle movements to and from the site with the delivery of material and return of empty trucks. **Table 7.1** presents the projected project generated traffic as number of trips.

Table 7.1: Project Daily Generated (vehicle trips)

Vehicle type	Morning	Early Afternoon	Early Evening
Heavy Vehicles	85	85	85

Source: Cardno 2016

Heavy vehicle movements are expected to occur at a constant rate throughout 3x3 hours shifts.

7.2 Methodology

The increase in road traffic noise levels was predicted using the Calculation of Road Traffic Noise (CoRTN).

The standard prediction procedures have been modified as follows:

- L_{Aeq} values were calculated from the L_{A10} values predicted by the CoRTN algorithms using the well-validated approximation of L_{Aeq},1hr = L_{A10},1hr – 3.
- All other factors such as distance, field of view, height of propagation and shielding were kept constant.

7.3 Traffic Volumes

The project will increase average daily heavy vehicles as per **Table 7.1**. The assessment has modelled the impact to account for the maximum number of vehicles accessing the Project via the Hume Highway during the daytime and night time periods.

Table 7.2 provides a summary of the existing traffic volumes on this road. Annual daily traffic volumes were referenced from the Project Traffic Assessment (Cardno 2016) based on traffic counts on the Hume Highway near Stacey Street south west of the Project.

Table 7.2: Existing Traffic Movements

	Day time 7 am – 10 pm		Night time 10 pm – 7 am	
Road section	Light Vehicles	Heavy Vehicles	Light Vehicles	Heavy Vehicles
Hume Hwy East Bound	14,426	796	4387	242
Hume Hwy West Bound	17,839	1212	3570	242

Traffic volumes associated with the Project have been added to the existing traffic volumes listed and the traffic noise impacts calculated utilising the method described. No additional road network traffic growth has been included giving a conservative estimate of traffic noise increase.

7.4 Assessment

The relative changes in noise level are presented in **Table 7.3** for the day time and night time periods for each road section.

Table 7.3: Predicted Increase in Traffic Noise Levels

Road	Distance (m)	Day Period (dB)	Night Period (dB)
Hume Hwy East Bound	20	0.1	0.3
Hume Hwy West Bound	40	0.1	0.4

A review of **Table 7.3** shows that the predicted traffic noise level increases as a result of the Project will increase existing levels by less than 1 dB which is below the 2 dB relative increase criteria.

8. Noise Management

Noise management is required to ensure that the Project operates within the criteria and to reduce the potential for increased noise emissions to occur. A Noise Management Plan should be developed for operation of the facility.

8.1 Operational Noise Management

Modelling has indicated that the rail loading scenario has the potential to exceed industrial noise criteria during the night time period. Where it is possible to limit this scenario to day and evening periods, noise impacts during the more sensitive night time period can be managed. To minimise noise impacts the following measures are recommended:

- Ensure plant and equipment are selected and maintained to achieve the sound power levels outlined in this report.
- Avoid impact noise such as gate crashing and door slamming during night time periods to minimise the potential for sleep disturbance.
- Route material trucks through the unload area in a forward direction only.
- Use broadband (non-tonal) reversing alarms in place of traditional beeper reversing alarms.
- Ensure plant and equipment is well maintained and not generating excessive noise.
- Avoid the use of horns and alarms.

8.2 Construction Noise Management

Based on the measured background noise levels during standard hours specific noise mitigation measures and anticipated

Construction noise for the earthworks and other construction activities should be effectively managed to minimise potential impacts. This would include development of noise and vibration management requirements within a Construction Environmental Management Plan (CEMP) prior to commencement of works onsite. This would utilise more detailed information in relation to the proposed construction methodology, activities, durations and equipment type and numbers. It is envisaged that the CEMP would consider the following at a minimum:

- The nearby residences and other sensitive land uses.
- The noise management levels identified in this assessment.
- Address the potential impact from the proposed construction methods.
- Develop reactive and proactive strategies for dealing with any noise complaints.
- Identify a site contact person to follow up complaints.

8.3 Road Traffic Noise Management

The road traffic assessment did not identify any exceedance of the increase to the existing traffic noise levels. However in order to manage noise from road traffic associated with the Project, road traffic noise management should be included as part of CEMP as well as an Operational Environmental Management Plan (OEMP). Measures to assist in the management of road traffic

noise should include staff and contractor education and training of road traffic noise impacts. The education should include educating drivers on appropriate driving behaviours to minimise noise generation. This would include adhering to posted speed limits and avoiding aggressive acceleration and driving styles.

9. Conclusion

An assessment of noise and vibration impacts from the proposed Chullora spoil loading facility has been conducted. This included background noise monitoring to establish noise criteria, modelling of constriction and operational noise impacts and the development of noise mitigation measures.

In relation to operational noise, the assessment indicated the following:

- There are no exceedances of noise criteria predicted during the day time or evening period.
- Train loading activity during the night time period is predicted to exceeded noise amenity criteria at several elevated residential receivers to the east of the site. Locomotive noise is the primary contributor to this exceedance.

Construction noise levels are not expected to result in adverse impacts at sensitive receivers with predicted noise levels below the assessment criteria for all construction scenarios for standard hours. No receivers are predicted to be highly noise affected (noise levels of 75 dB(A) or above) for any of the construction scenarios.

The road traffic noise assessment indicated that increases in traffic noise would be below the traffic noise increase criteria of 2 dB.

Noise management measures were recommended which included the development of a noise management plan within the CEMP and OEMP.

10. References

CONCAWE Report No. 4/81, Manning C.J., 1981, *The propagation of noise from petroleum and petrochemical complexes to neighbouring communities.*

German Standard DIN 4150-3-(1999), *"Structural Vibration – Part 3 Effects of vibration on structures"*

NSW Department of Environment Climate Change (2009), *Interim Construction Noise Guideline* (ICNG).

NSW Department of Environment Climate Change and Water (2011) *Road Noise Policy* (RNP).

NSW Department of Environment Conservation (2006), *Assessing Vibration: A Technical Guideline*.

NSW Environmental Protection Authority (1999), *Environmental Criteria for Road Traffic Noise* (ECRTN).

NSW Environmental Protection Authority (2000), *Industrial Noise Policy* (INP).

NSW Environmental Protection Authority (2008), *Industrial Noise Policy Application Notes.*

Transport for NSW (2016), *Construction Noise Strategy*

World Health Organization (1999), Guidelines for Community Noise, World Health Organization, Geneva.

Appendix A

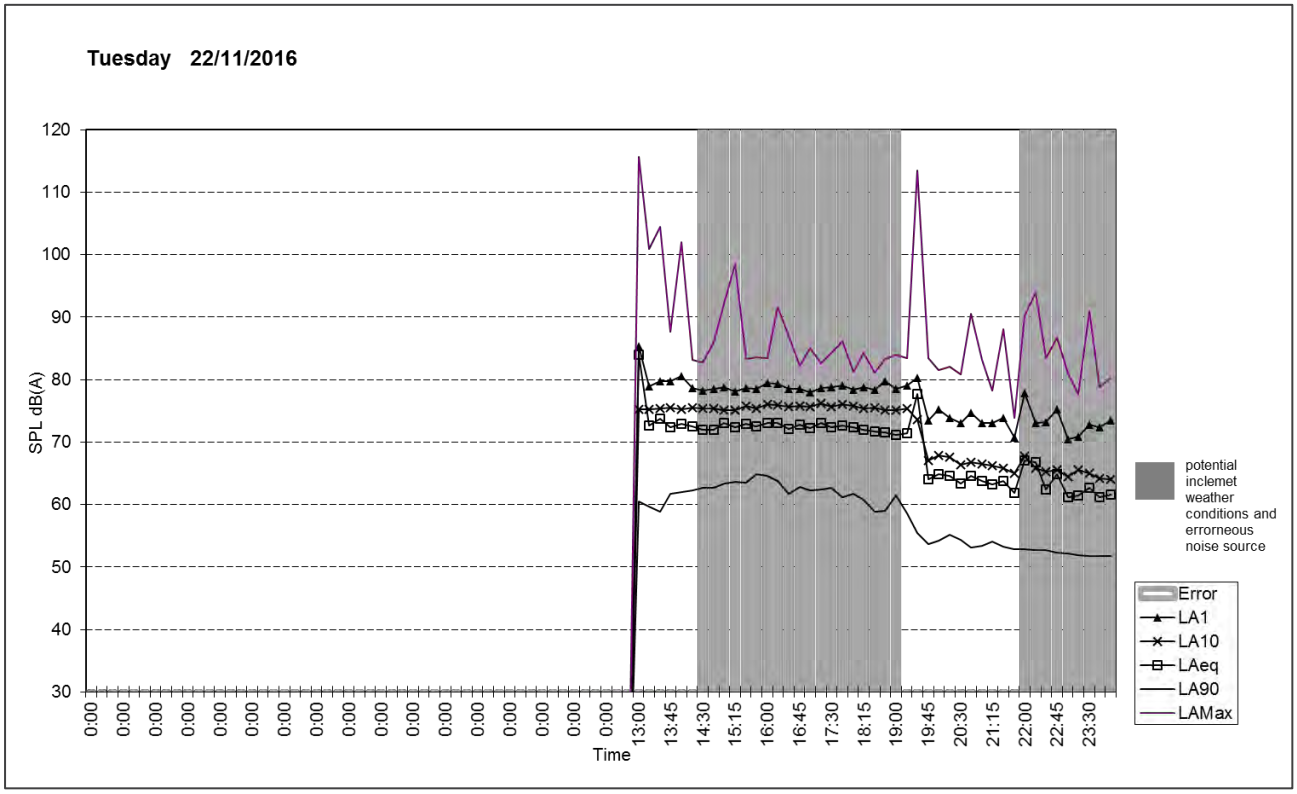
Receiver Coordinates

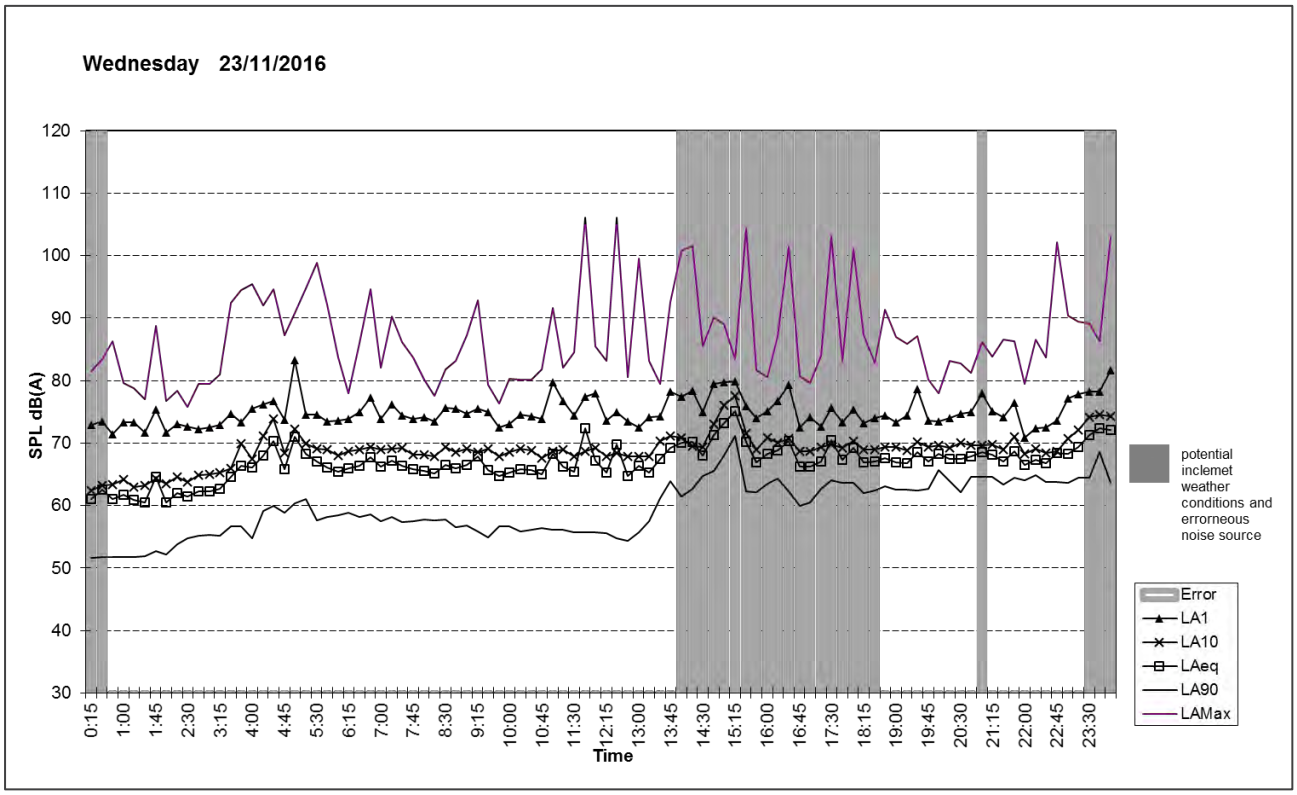
Table A.1: Receiver Coordinates

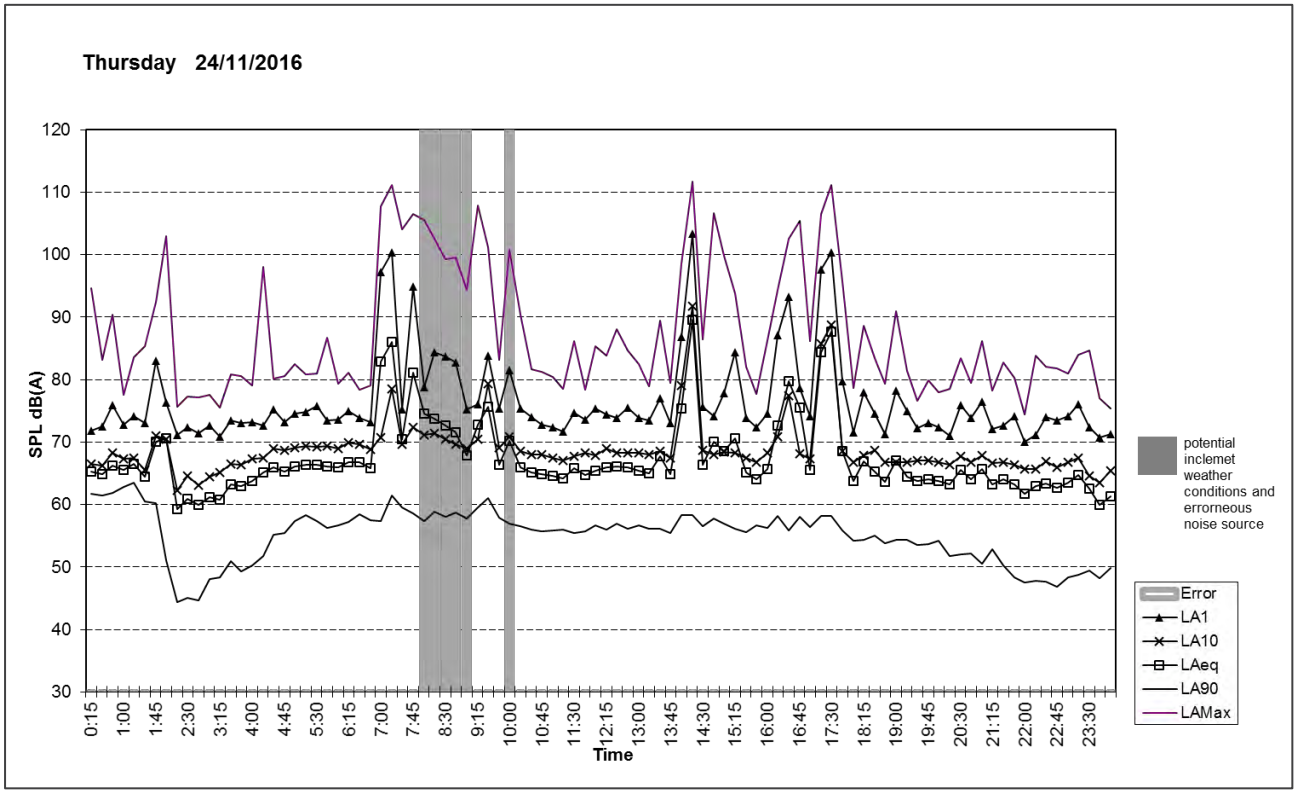
ID	Easting	Northing	Height (m)
R1	321109	6249064	1.5 to 4.5
R2	321062	6249027	1.5 to 4.5
R3	321057	6248993	1.5 to 4.5
R4	321033	6248957	1.5 to 4.5
R5	321037	6248919	1.5 to 4.5
R6	321062	6248886	1.5 to 4.5
R7	321162	6248750	1.5
R8	321115	6248731	1.5
R9	321082	6248719	1.5
R10	321046	6248710	1.5
R11	320986	6248682	1.5
R12	320954	6248669	1.5
R13	320927	6248645	1.5
R14	320807	6248562	1.5
R15	320793	6248544	1.5
R16	320768	6248526	1.5
R17	320732	6248491	1.5
R18	320705	6248466	1.5
S1	321732	6248832	1.5
S2	320690	6248192	1.5
C1	320599	6248344	1.5
C2	320865	6248609	1.5

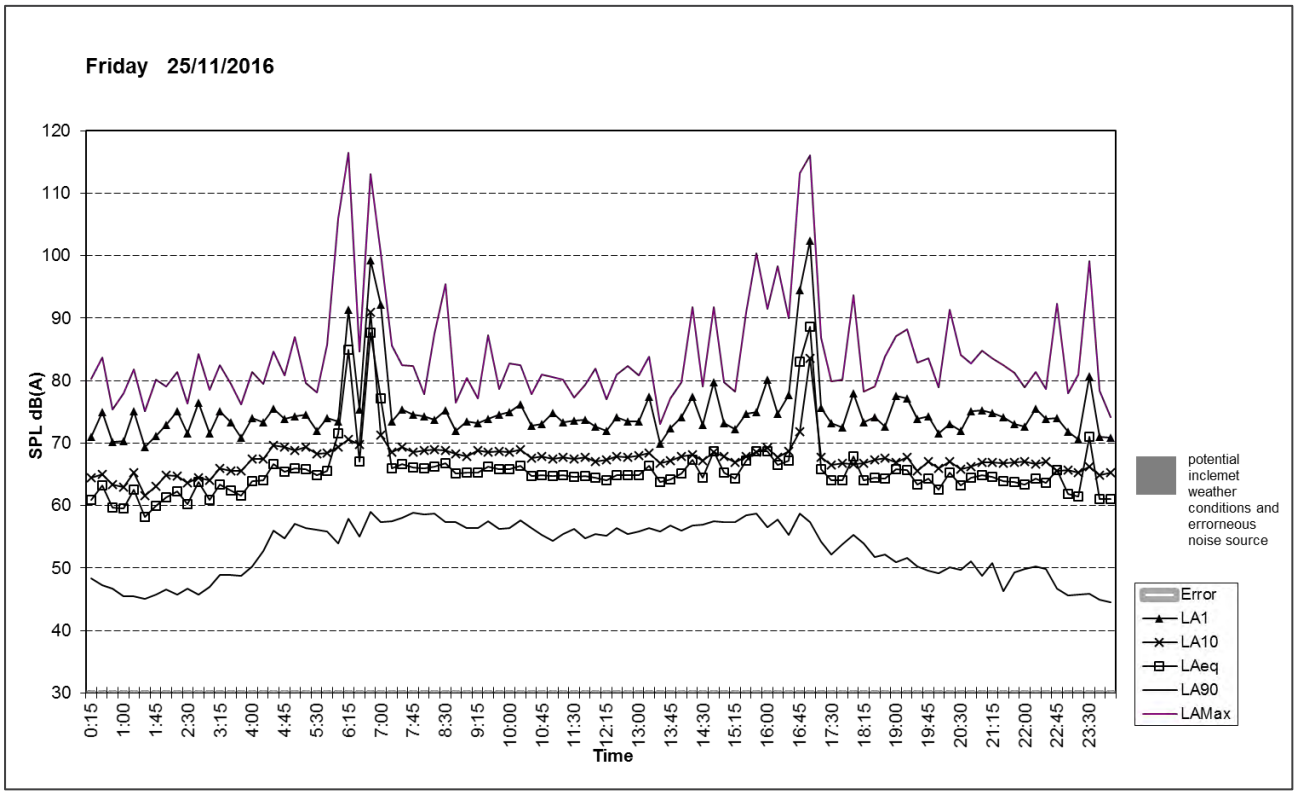
Appendix B

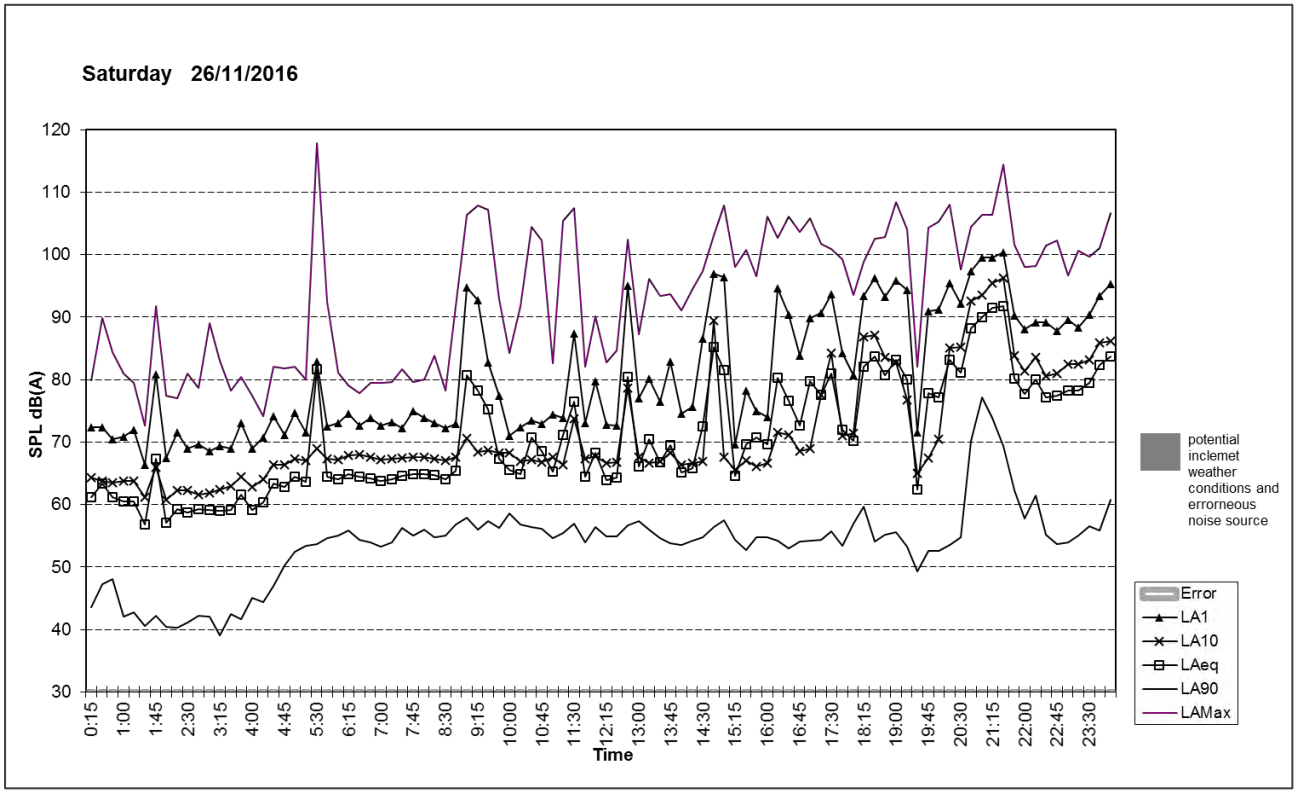
Logger Data

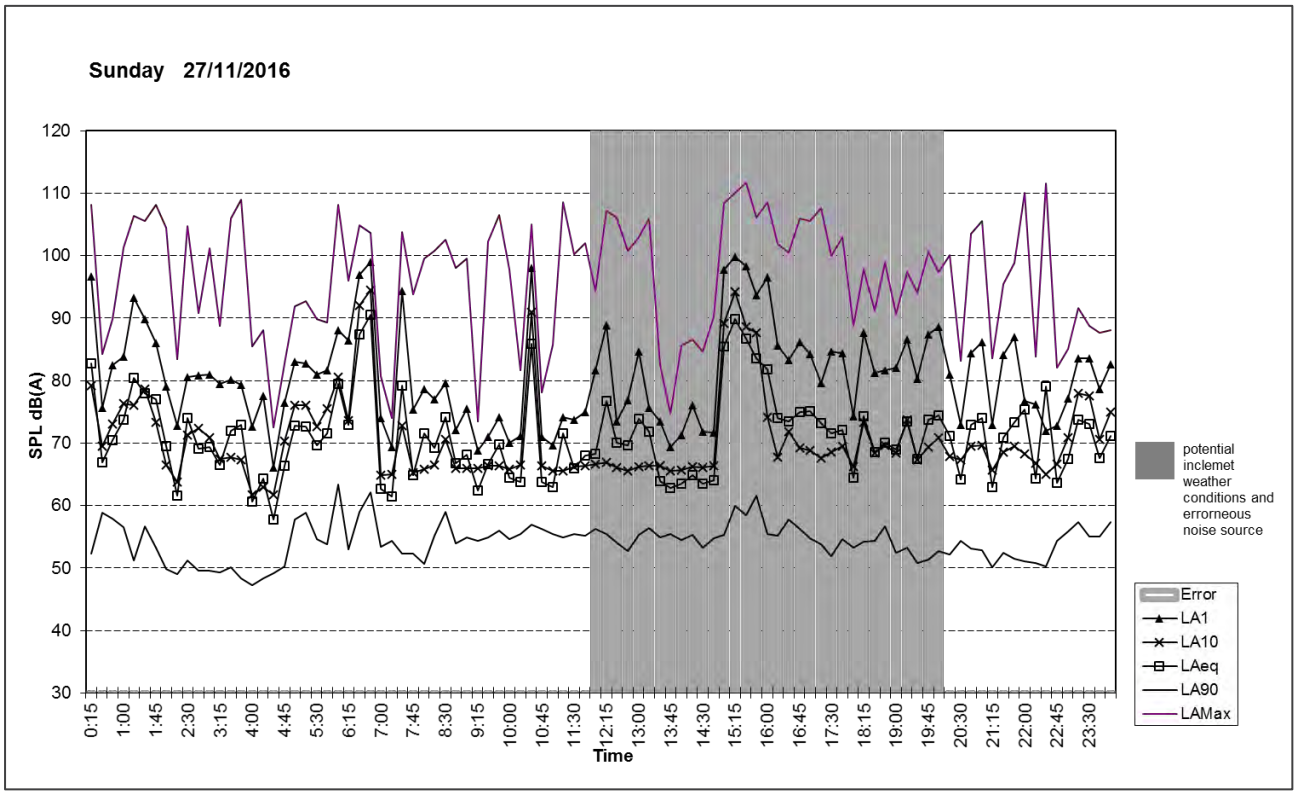


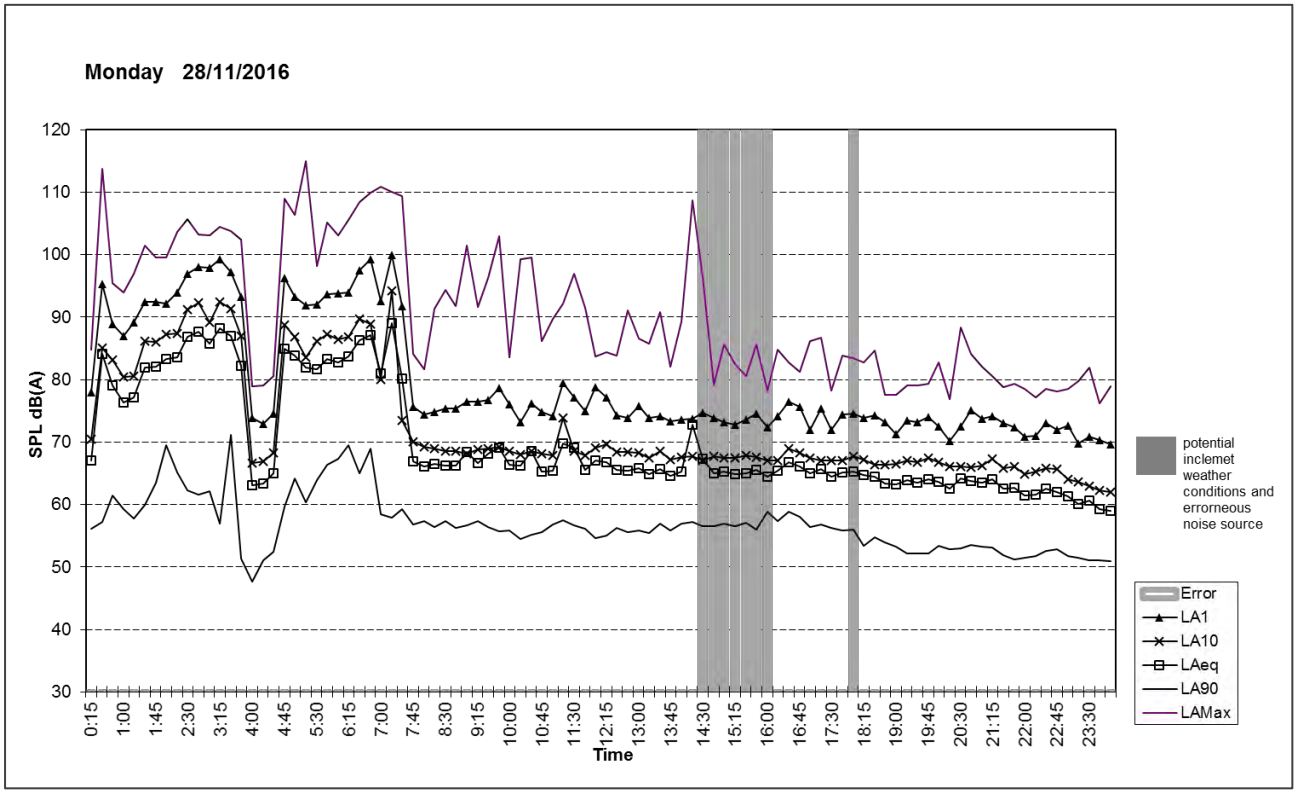


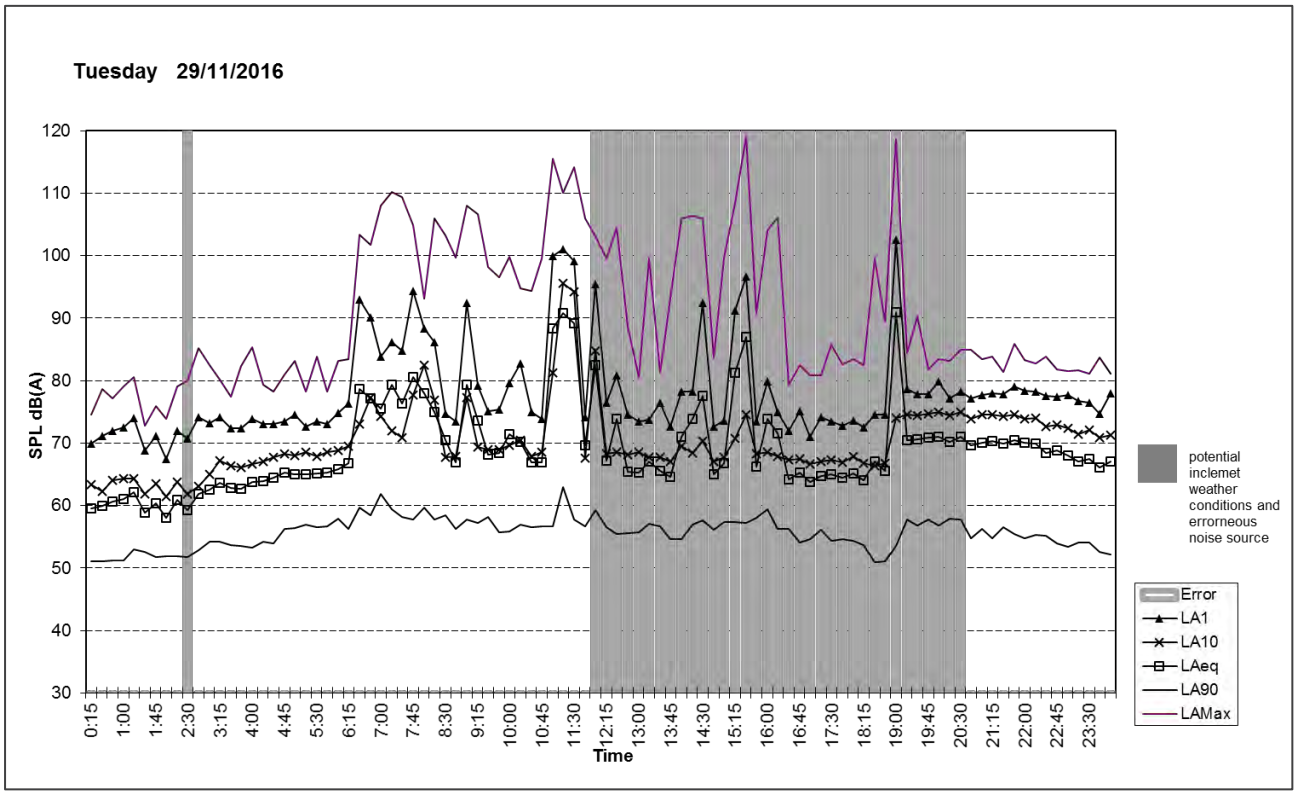


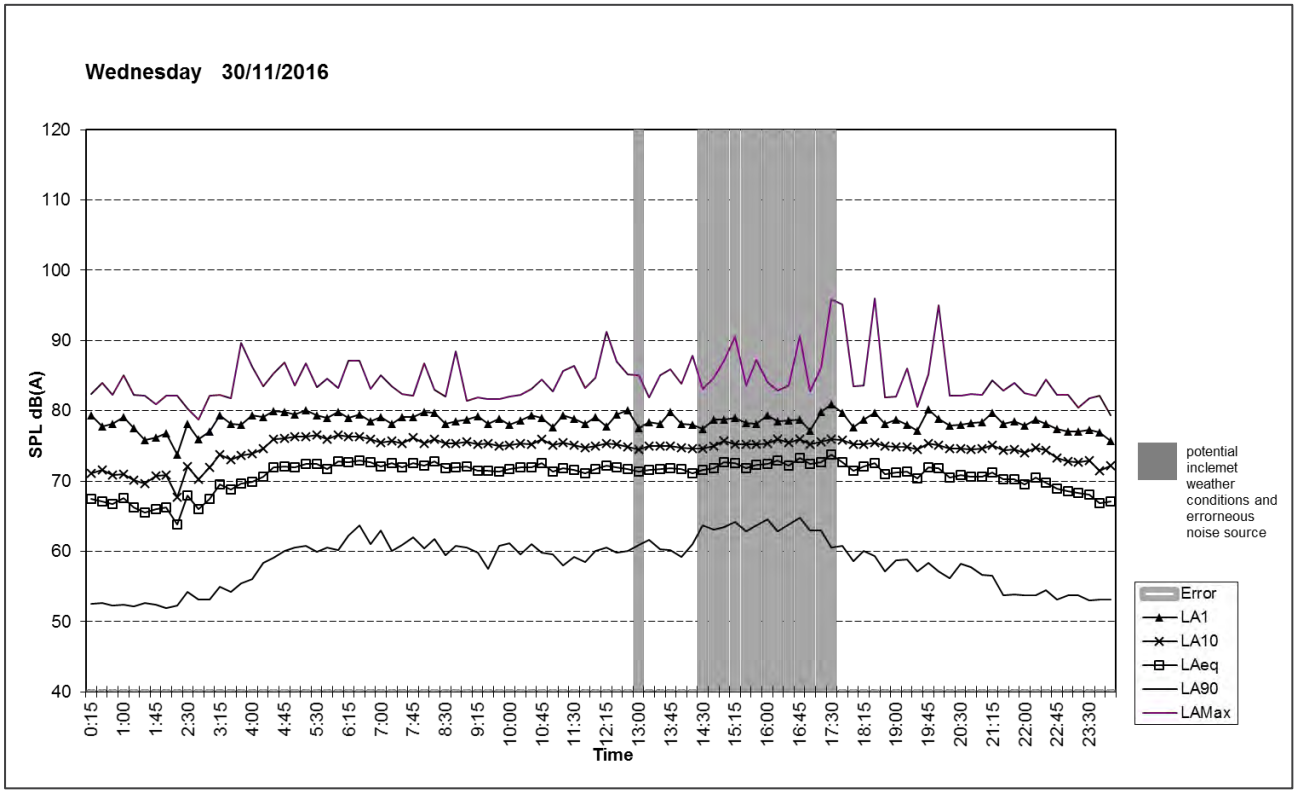


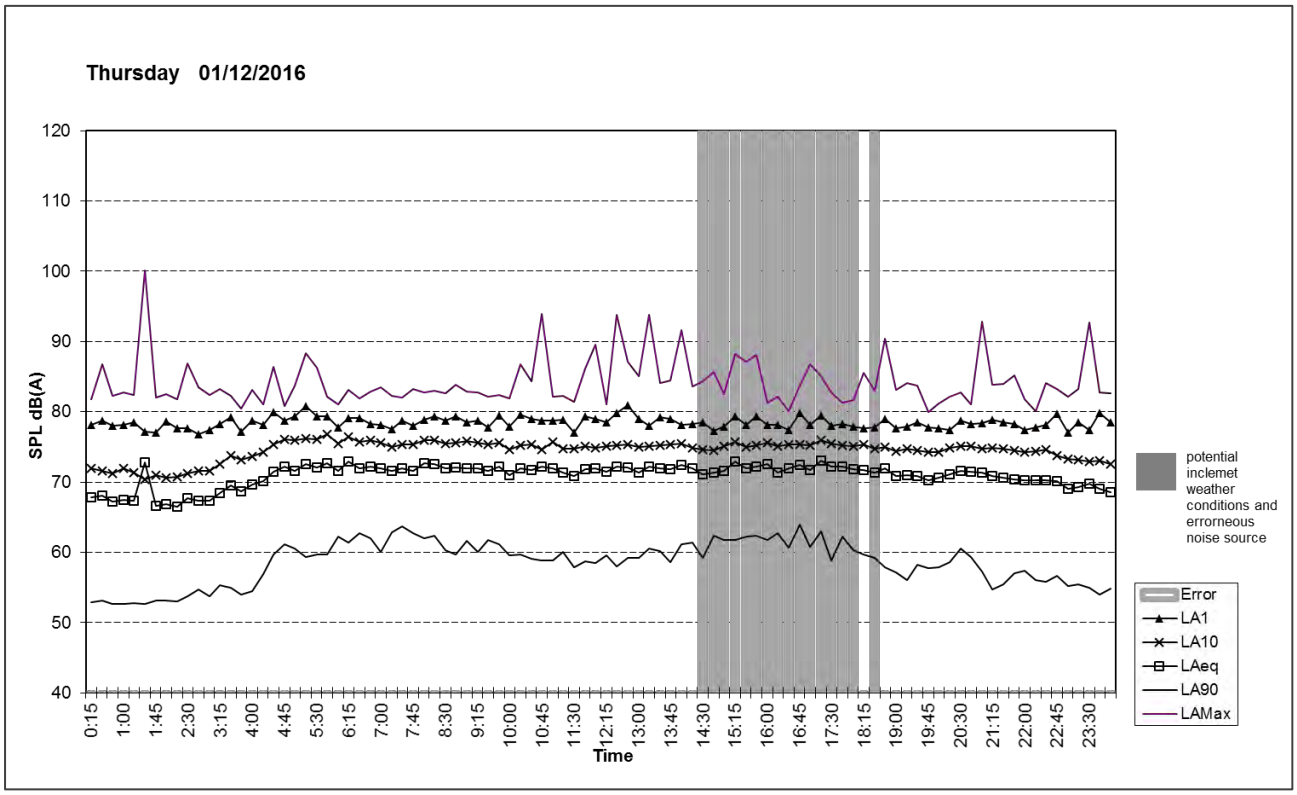


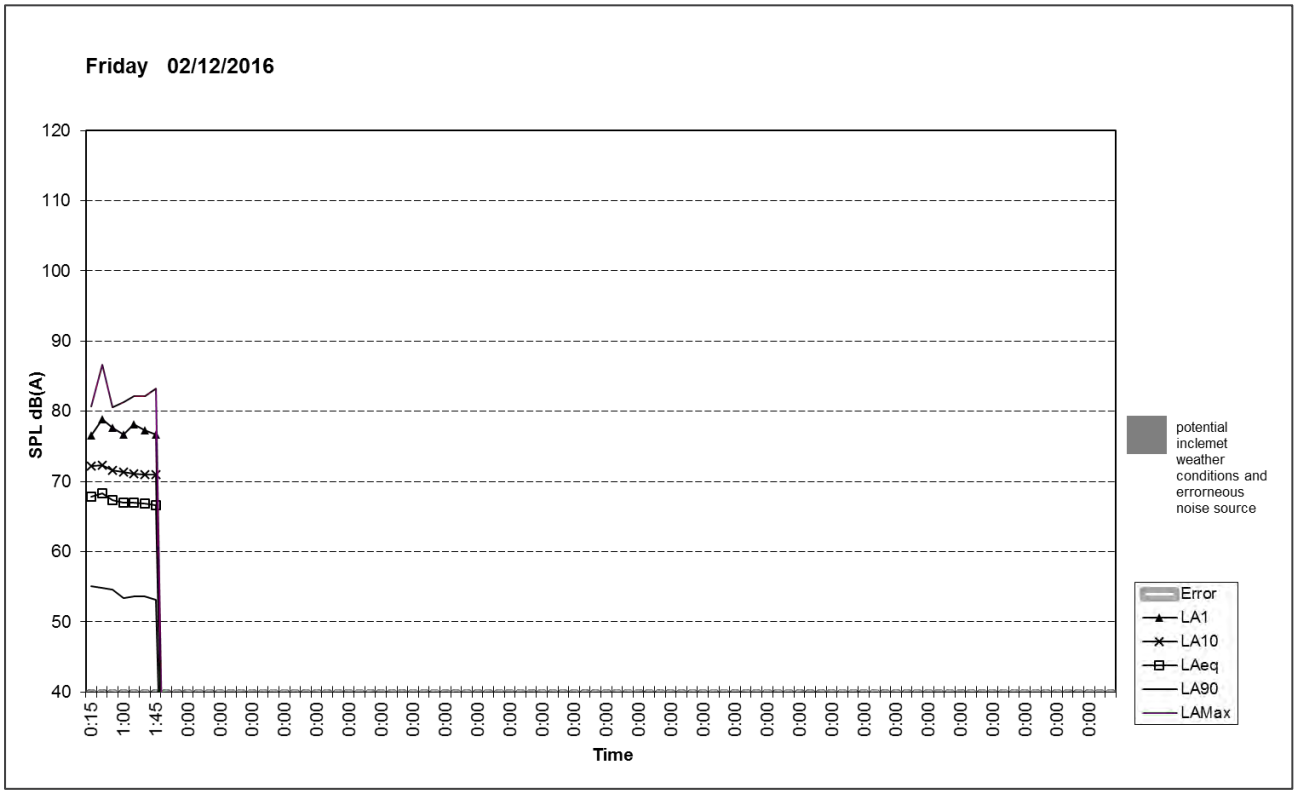








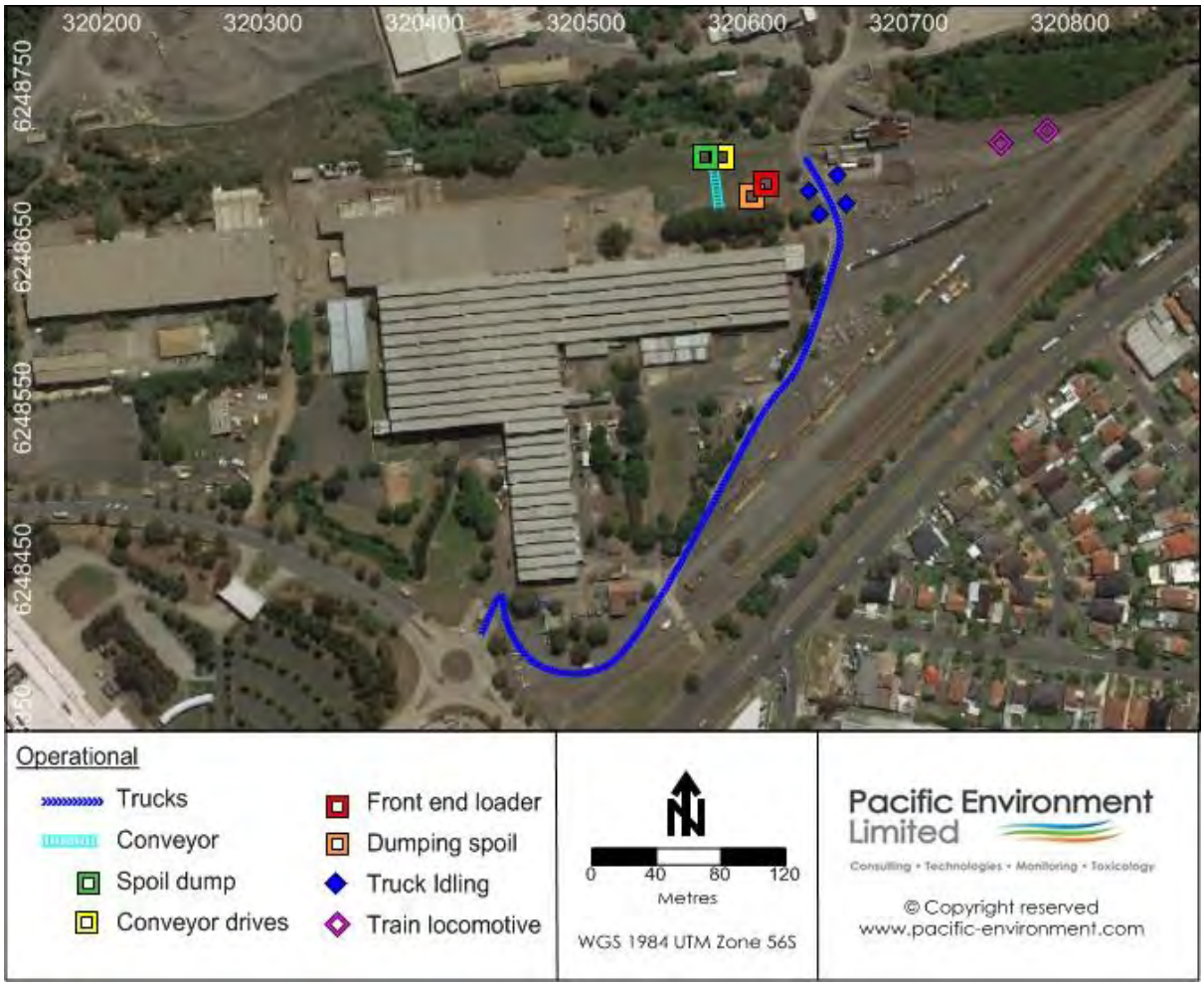




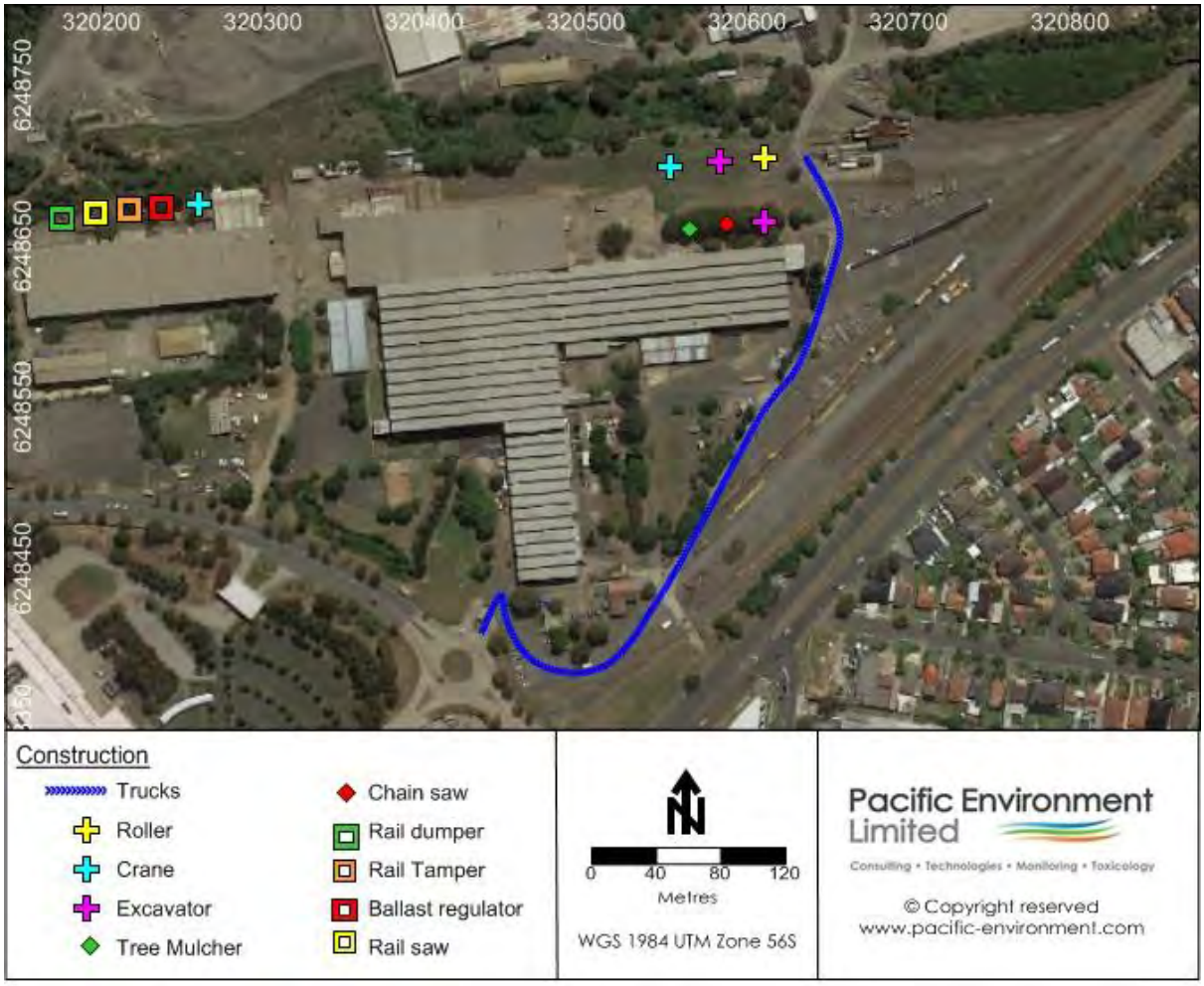
Appendix C

Source Locations

C.1 OPERATIONS



C.2 CONSTRUCTION

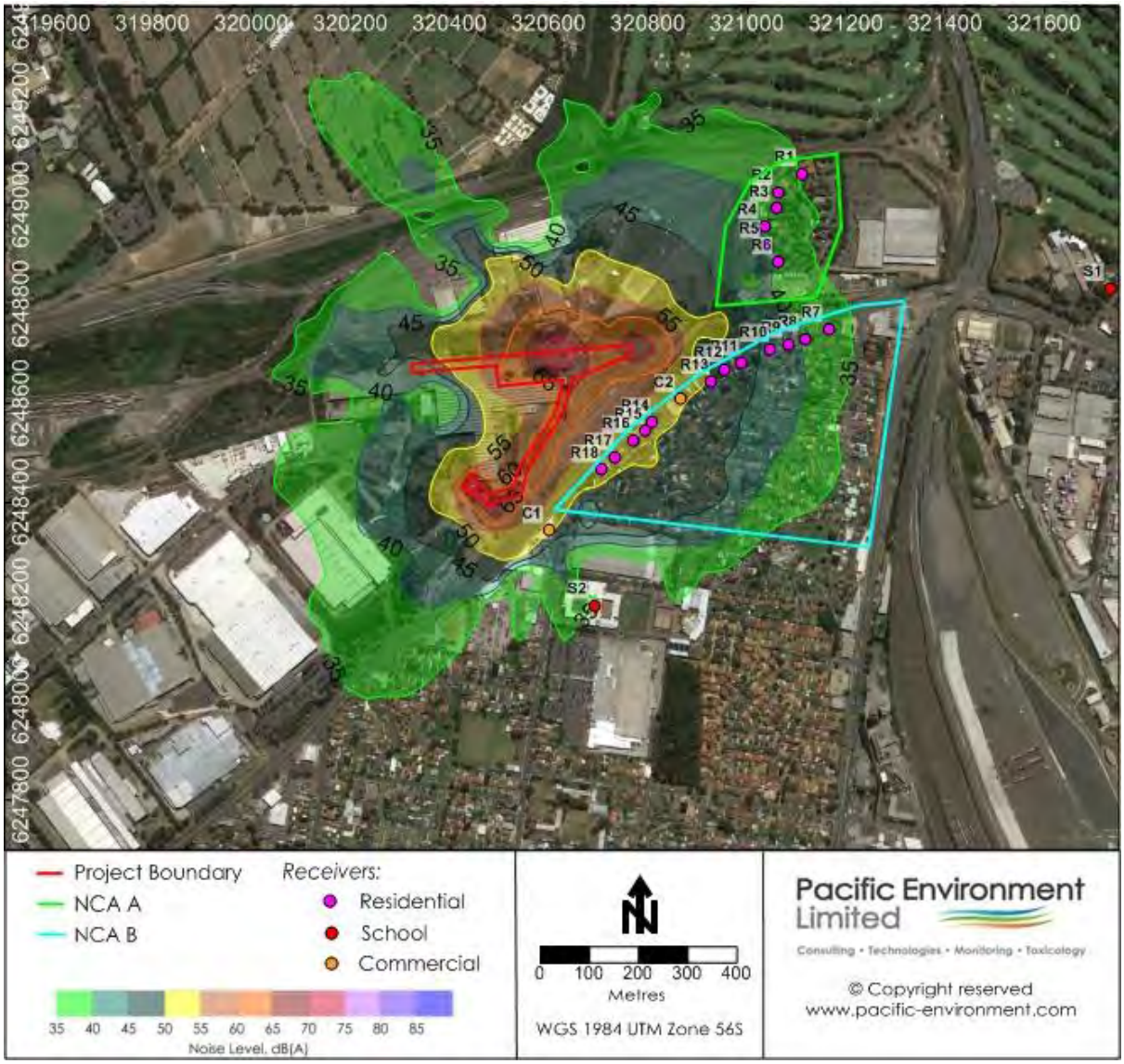


Appendix D

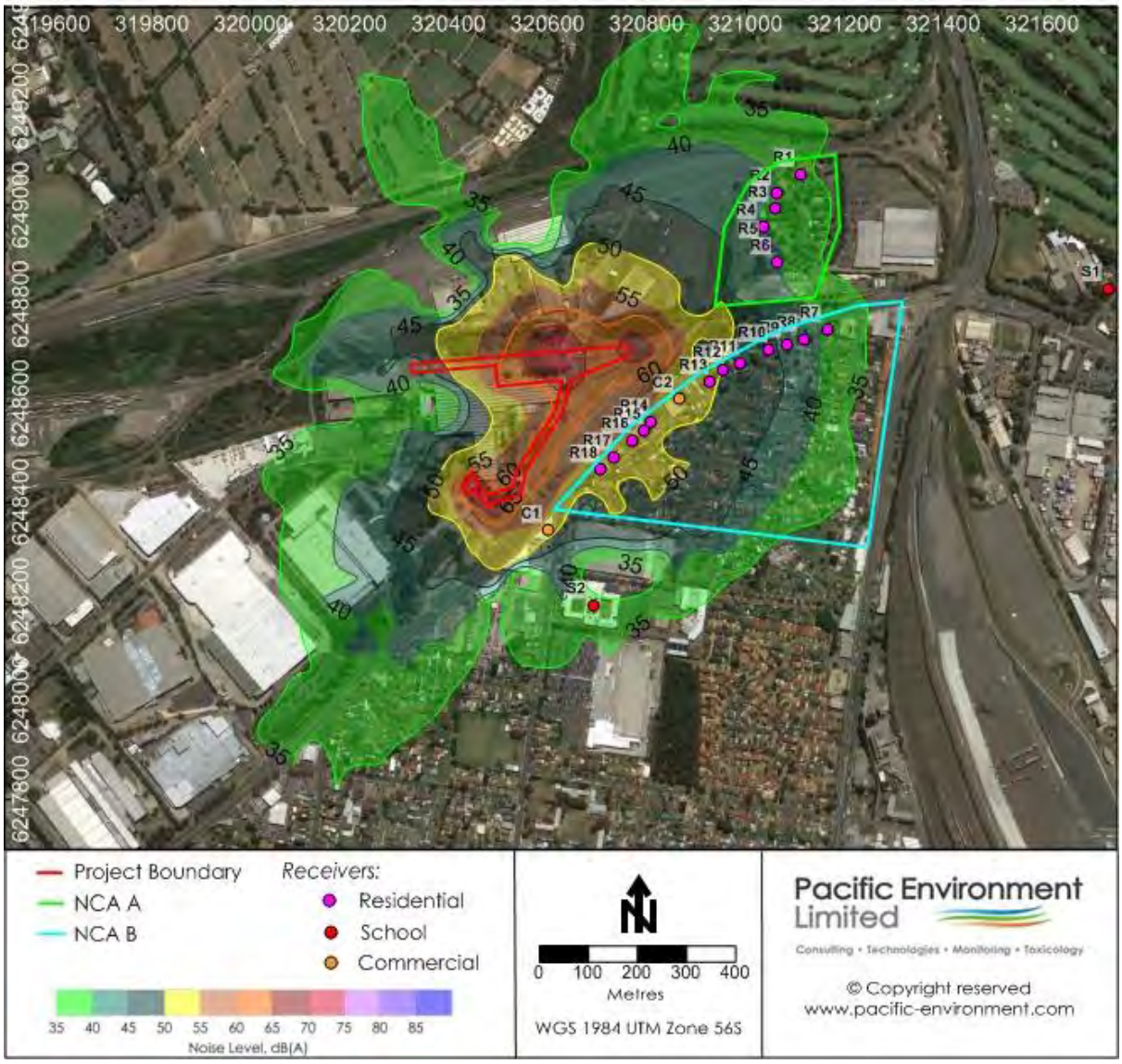
Noise Contours

D.1 OPERATIONAL SCENARIO 1

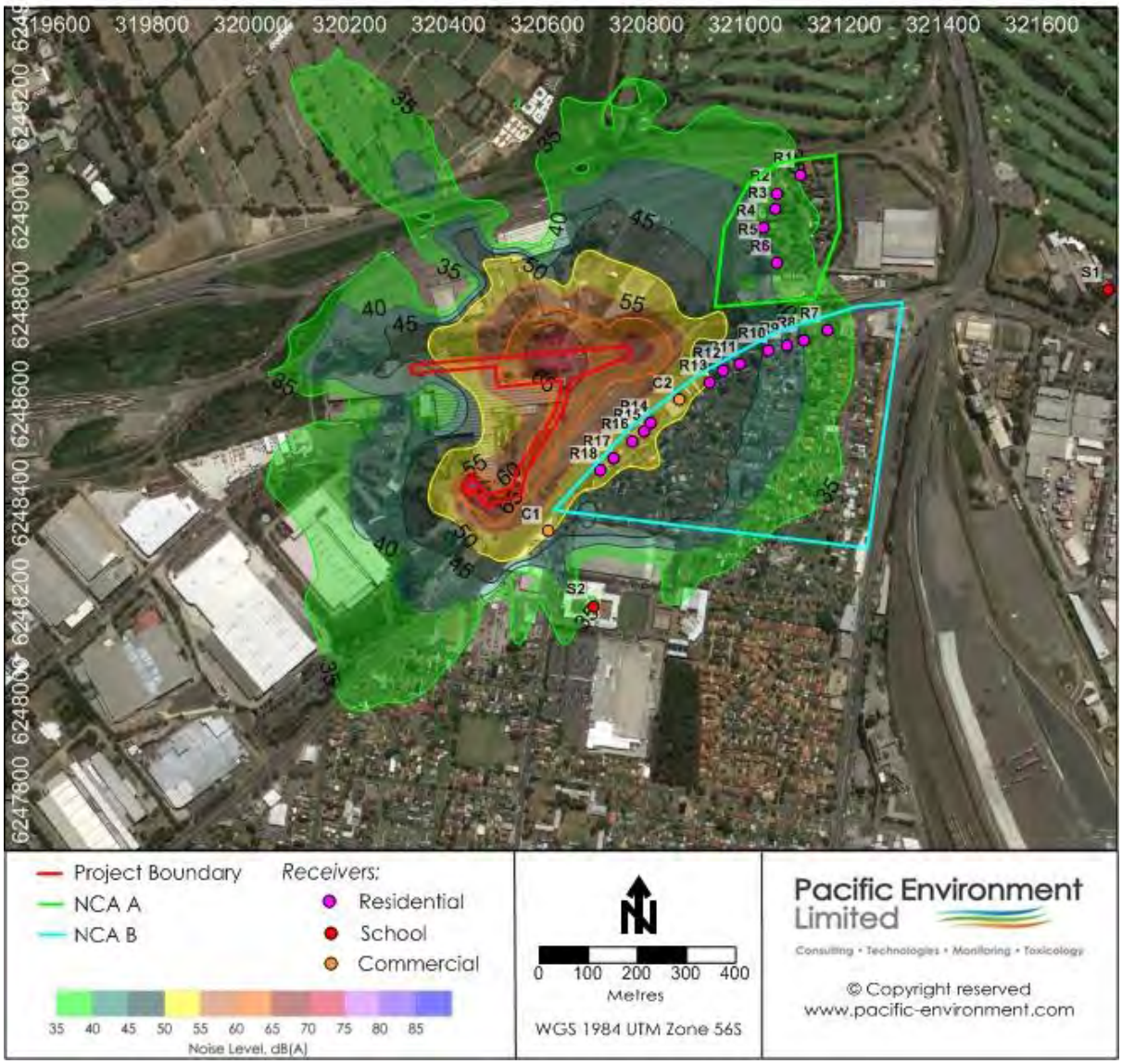
D.1.1 Day time, neutral conditions.



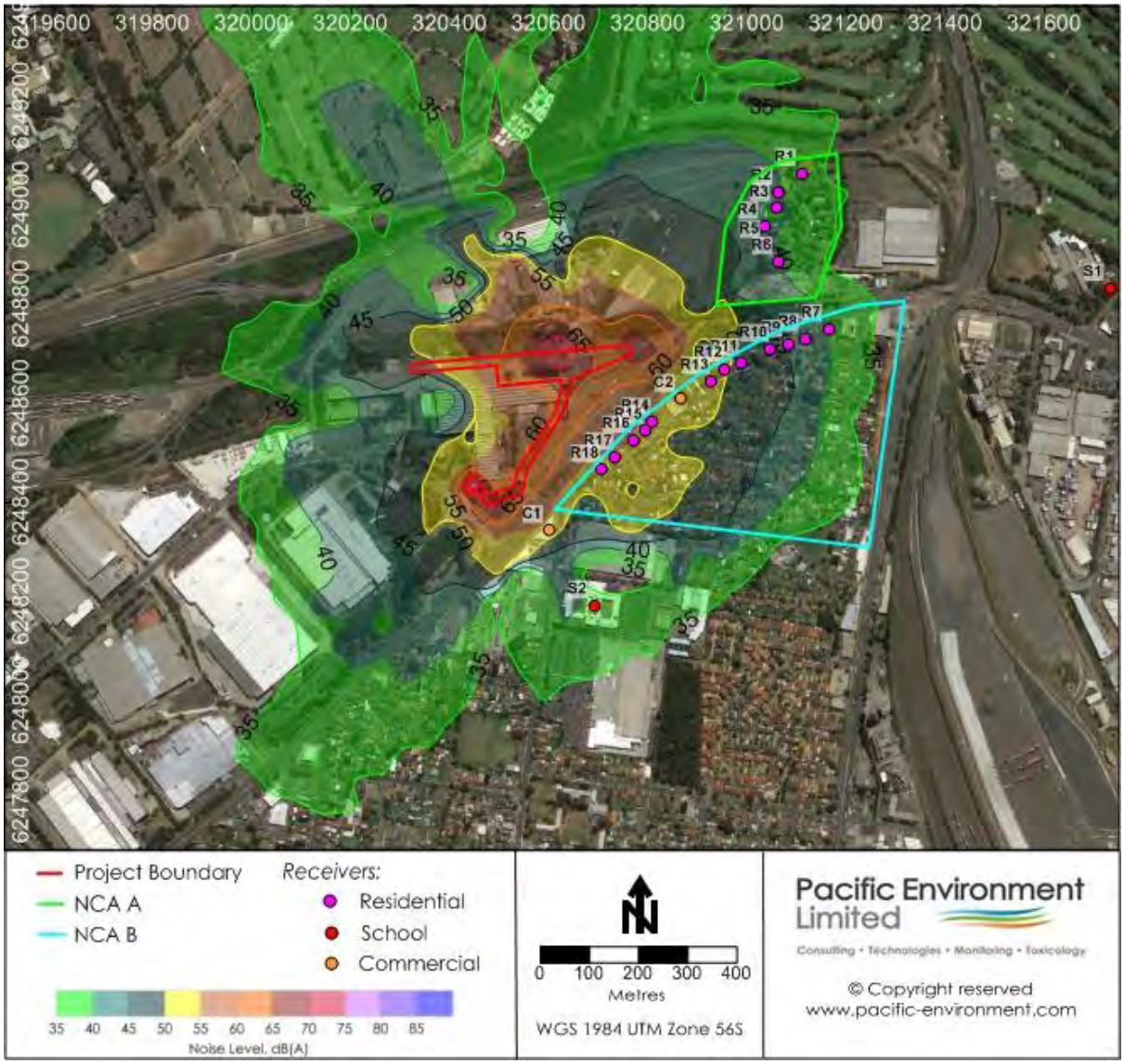
D.1.2 Day time, noise enhancing.



D.1.3 Nigh time, neutral conditions.

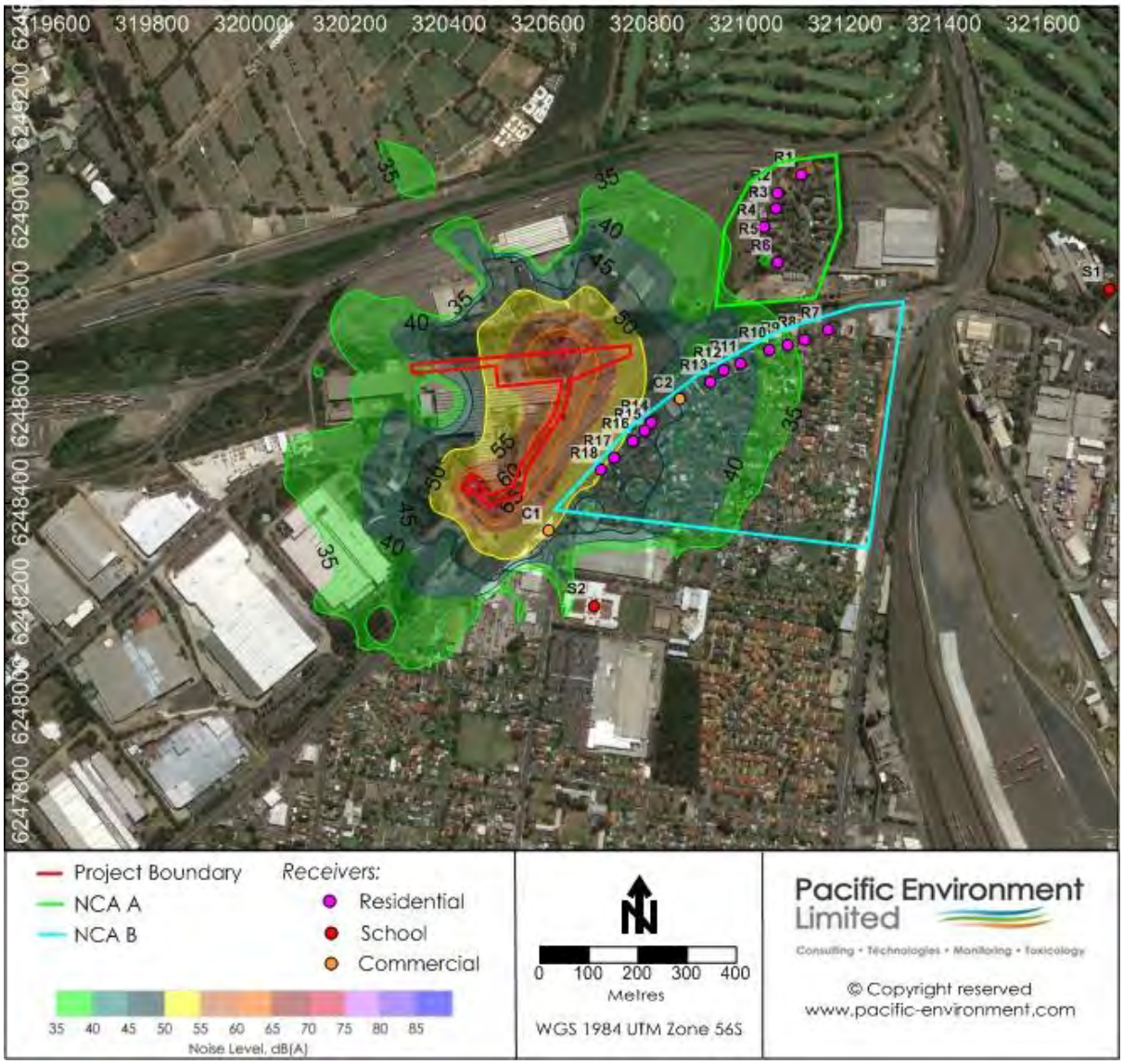


D.1.4 Nigh time, noise enhancing.

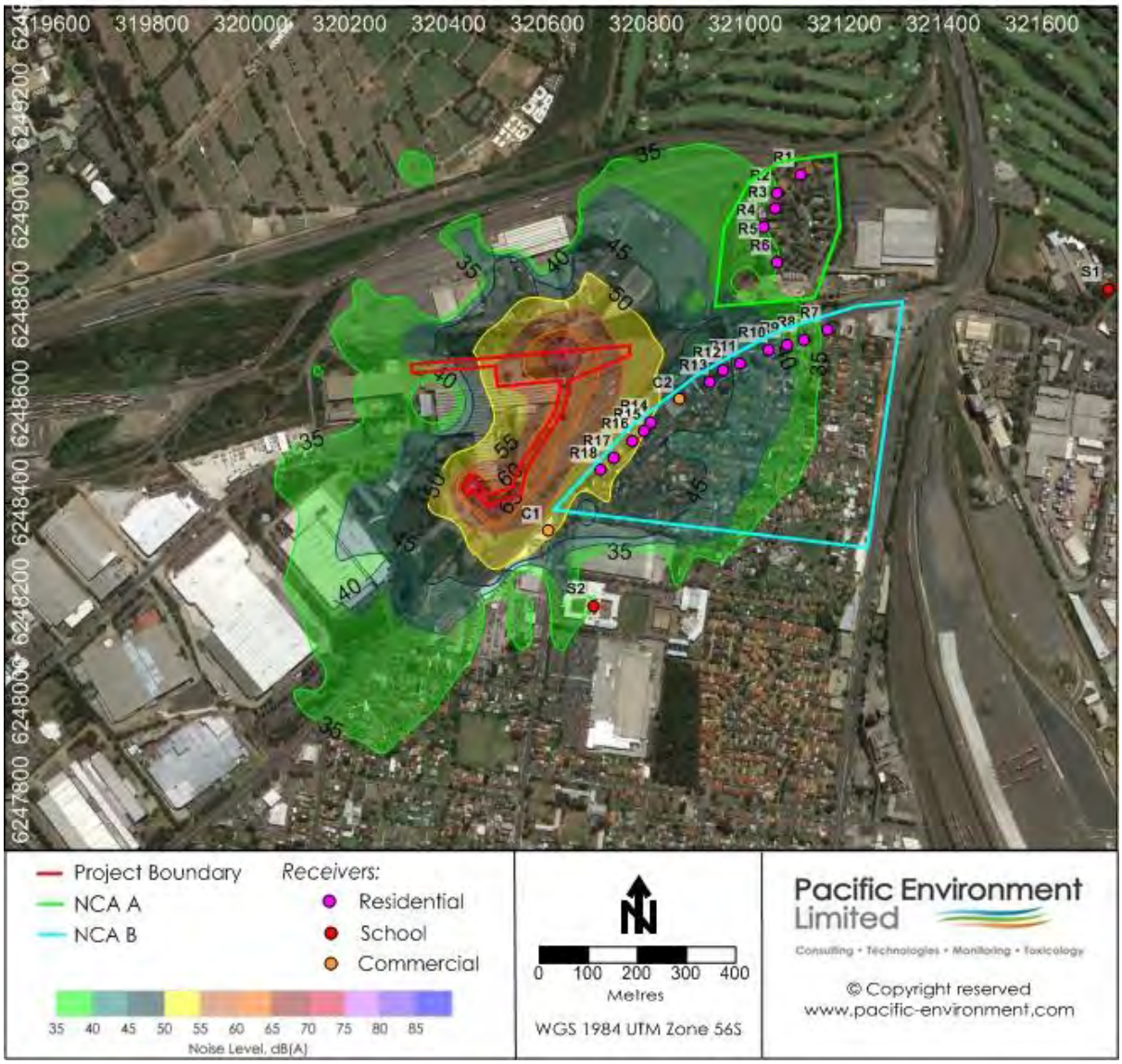


D.2 OPERATIONAL SCENARIO 2

D.2.1 Day time, neutral conditions.



D.2.2 Day time, noise enhancing.



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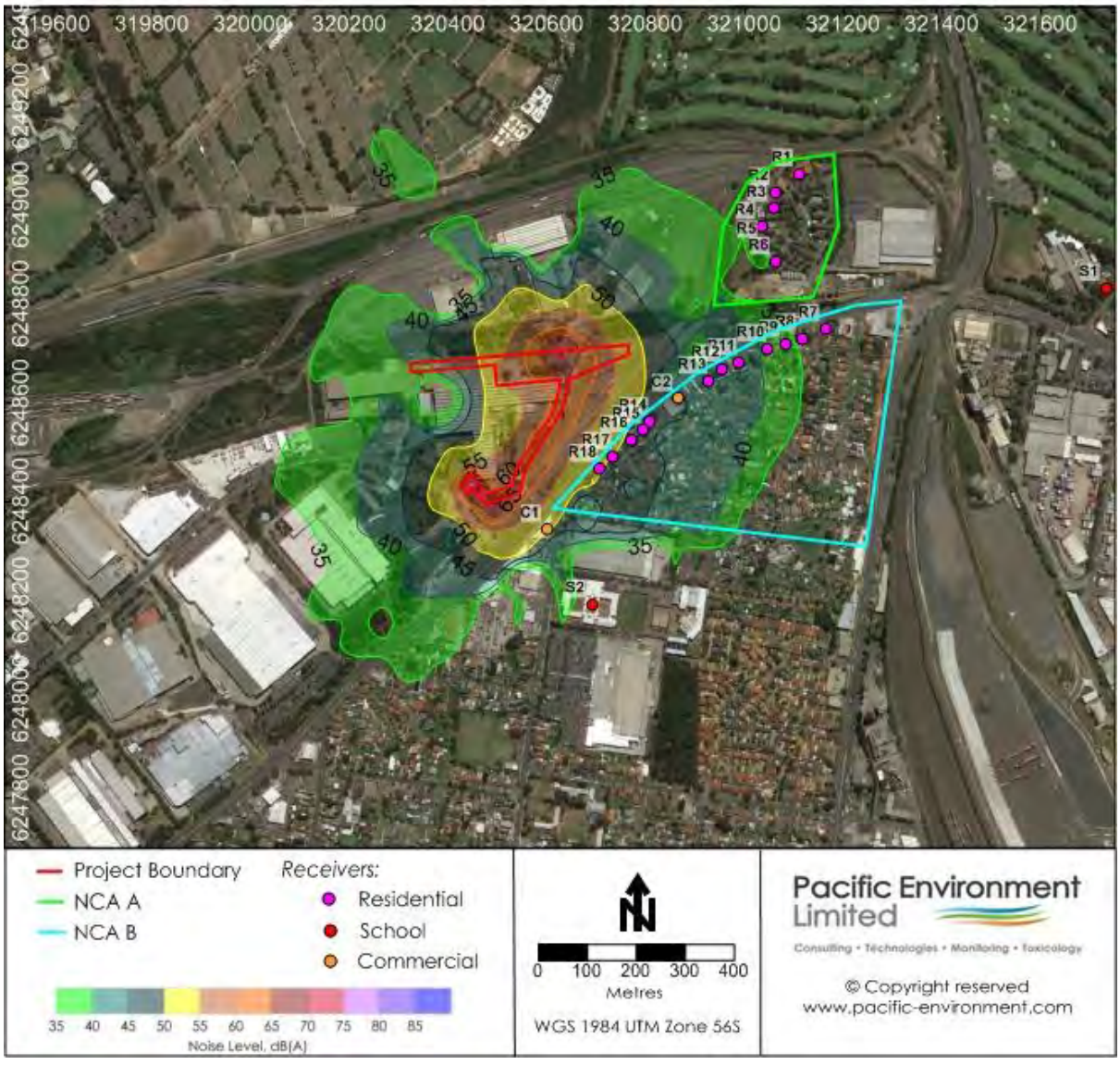
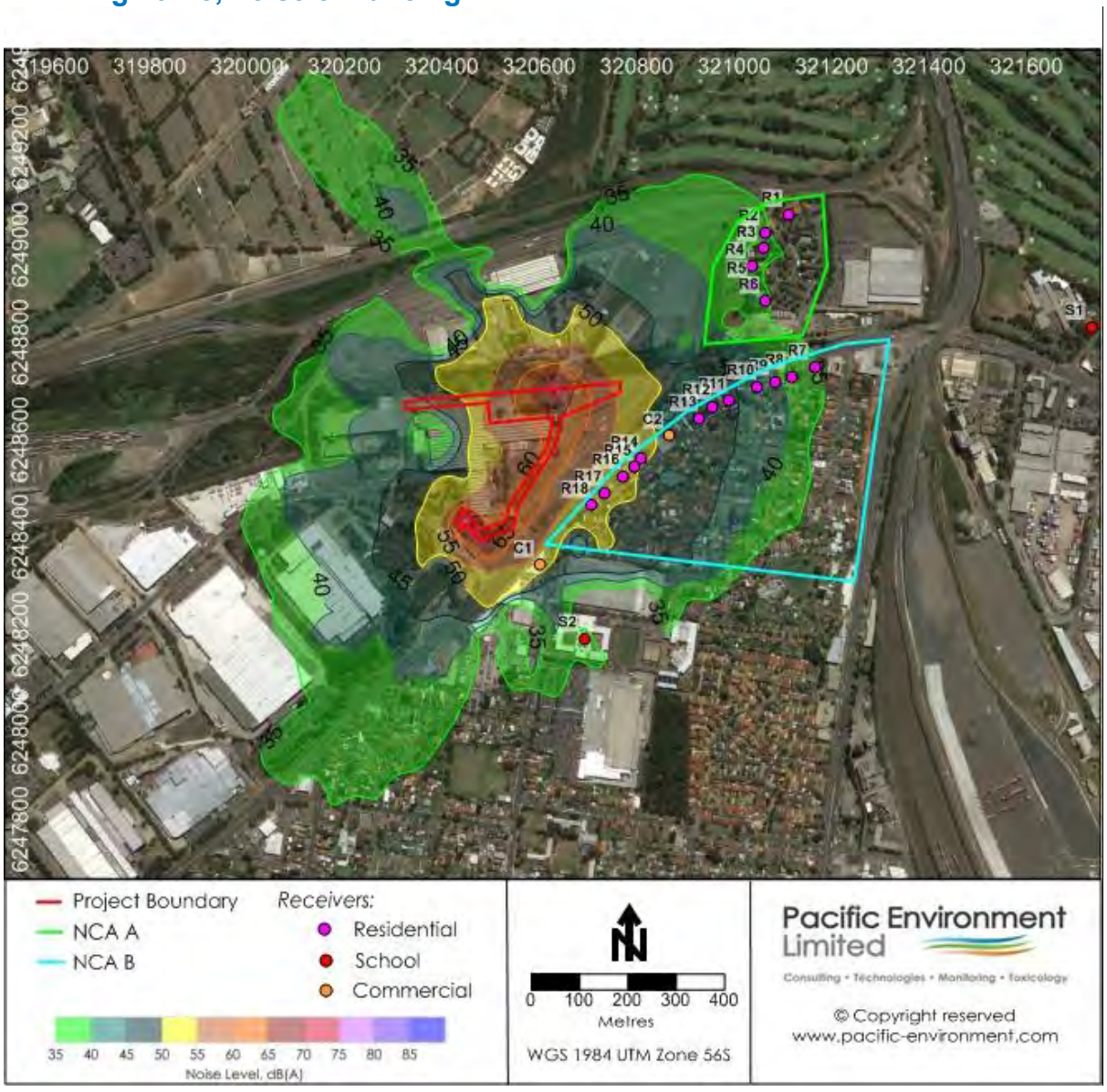


D.2.4 Nigh time, noise enhancing.



Appendix 5 – Statement of Heritage Impact

Chullora Railway Workshops: Heritage Assessment and Statement of Heritage Impact

Prepared for Cardno

20 January 2017

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Final version 01	Jane Raithby-Veall	16/12/2016
Final version 02	Alexander Beben	20/01/2017

Acknowledgements

Biosis gratefully acknowledges the contributions of the following people and organisations (listed alphabetically) in preparing this report:

- Cardno: Chris Meikle
- Cardno: Daniel Thompson.

Biosis staff involved in this project were:

- Alexander Beben for assistance in the field
- Lauren Harley for mapping.

Contents

Tables

Figures

Plates

Glossary

c.	Circa
CHL	Commonwealth Heritage List
CMP	Conservation Management Plan
DA	Development Application
DECCW	Department of Environment, Climate Change and Water (now OEH)
DP	Deposited Plan
DPI	Department of Planning and Infrastructure
EPA	Environment Planning and Assessment
LEP	Local Environmental Plan
m	Metre
mm	Millimetre
OEH	Office of Environment and Heritage, Department of Premier and Cabinet
REF	Review of Environmental Factors
SHI	State Heritage Inventory
SHR	State Heritage Register
SoHI	Statement of Heritage Impact
VENM	Virgin Excavated Natural Material

Summary

Biosis Pty Ltd has been commissioned by Cardno on behalf of Transport for New South Wales (TfNSW) to undertake an historic period heritage assessment and statement of heritage impact (SoHI) for the proposed project at Chullora Railway Workshops, Chullora NSW (Figure 1). The project involves the conversion of one area for railway related uses –the 'UGL site' for use as a Virgin Excavated Natural Material (VENM) staging zone. The initial brief also identified that the 'Igloo site' would be used as a ballast stockpiling area, however this site has been removed from the scope of works.

Background research and field survey identified a number of items of heritage significance within the wider Chullora Railway Workshops precinct, which is listed on the TfNSW section 170 heritage register, which would be impacted by the proposed works. All of these items have been previously identified, and the assessment has not uncovered any new heritage items or areas of archaeological potential.

The proposed works involve impacts to a number of structures and features within the Chullora Railway Workshops. All items have previously been assessed as part of the development of a Conservation Management Plan (CMP) for the workshops. This assessment has identified that all proposed works are in accordance with the CMP and have the potential to positively impact the site by utilising the area for inter-modal purposes (road to rail), which are a railway related use

Provided that the recommendations are adopted for the project as well as any additional conditions of approval, the project may proceed with minimal loss of significance.

These recommendations have been formulated to respond to client requirements and the significance of the site. They are guided by the ICOMOS *Burra Charter* with the aim of doing *as much as necessary and as little as possibl*e, in order to make a site useable while retaining its cultural significance.[1]

Recommendation 1: The project may proceed with conditions

Based on the assessment made in this report, it is considered that the proposed development represents an acceptable impact on the Chullora Railway Yards, provided that the following mitigation measures are adopted.

Recommendation 2: Prepare an archival record prior to impacts, during construction and at the completion of the project

Given the nature of the works, it is recommended that an archival recording be undertaken for the Locomotive Yard. Ensure that the archival record is prepared in accordance with the Heritage Branch guidelines *How to Prepare Archival Records for Heritage Items* and *Photographic Recording of Heritage Items Using Film or Digital Capture* (Heritage Office 2001, revised 2004, 2006).

Recommendation 3: Avenue of Mature Trees to remain

Avoid impacts to the Avenue of Mature Trees to preserve them in their current setting. Pruning of the trees is acceptable under the CMP if required, however additional approval would be required from TfNSW.

[1] "The Burra Charter 1999", The Australia ICOMOS Charter of Places of Cultural Significance.

Recommendation 4: Prohibited works

No works or activities are to occur outside of the UGL site as defined in Figure 2 of this report, or which may impact on heritage items which have not been assessed by this report without prior consultation with a heritage specialist regarding the potential impacts of this work.

1 Introduction

1.1 Project background

Biosis Pty Ltd has been commissioned by Cardno on behalf of Transport for New South Wales (TfNSW) to undertake an historic period heritage assessment and statement of heritage impact (SoHI) for the proposed project at Chullora Railway Workshops, Chullora NSW (Figure 1). The project involves the conversion of the 'UGL site' for use as a Virgin Excavated Natural Material (VENM) staging zone.

1.2 Study area

The study area is a property at 2 Worth Street Greenacre, NSW in the Parish of Liberty Plains, County of Cumberland (Figure 1). It is spread across the suburbs of Greenacre and Chullora and falls mostly within the Strathfield Local Government Area (LGA) with a small portion within the Canterbury-Bankstown Council (Council). The study area includes parts of Lot 1 DP 883526 and a small portion of Lot 1 DP 745651 (Figure 2).

1.3 Project description

The Spoil Management Pathway Project (the Project) will establish an integrated transport path to transfer of Virgin Excavated Natural Material (VENM) from the M4/M5 excavations, to civil construction projects in the Illawarra Region. The Project will see:

- Outgoing sandstone VENM from the M4/M5 extractions sites transported by road to the Sydney Trains Chullora yard in Sydney.
- The trucks will tip to direct load train wagons.
- Should trains not be in place, a temporary surge pile with a capacity of 3,000 tonnes of material (one train load) is allowed for at Chullora.
- Three 3,000 tonnes (net payload) trains will transport the VENM to Port Kembla. This equates to 9,000 tonnes per day.
- Incoming VENM will be direct transferred from train to truck at the BlueScope Steel CRM yard at Port Kembla.

It is proposed that some material will be temporarily placed on the ground at CRM during modal transfer to form a surge pile. No materials will be stored at either site (i.e. stockpiled); although some (no more than one train's worth = 3,000 tonnes) materials may be temporarily deposited during inclement weather or during mechanical maintenance, before being loaded out. Should delays be encountered during the transfer process, material would be held at the M4/M5 excavations and then directed to alternative sites throughout Sydney, ensuring that stockpiling is not required at Chullora or CRM.

During temporary storage surge piles would be sprayed down to supress dust, with a sediment and erosion control system in place to capture and treat and stormwater run off.

1.4 Planning approvals

The proposed development will be assessed against Part 5 of the *Environmental Planning and Assessment Act 1979* NSW in accordance with clause 94 of the State Environmental Planning Policy (Infrastructure) 2007. Other relevant legislation and planning instruments that will inform this assessment include:

- *Environmental Protection and Biodiversity Conservation Act 1999*
- *Heritage Act 1977 (NSW)*
- State Environmental Planning Policy (Infrastructure) 2007
- *National Parks and Wildlife Act 1974* (NSW)
- *National Parks and Wildlife Amendment Act 2010* (NSW)
- Strathfield Local Environmental Plan 2012 (LEP)
- Bankstown Local Environmental Plan 2015.

1.5 Report methodology

This report was prepared in accordance with current heritage guidelines including Assessing Heritage Significance, Assessing Significance for Historical Archaeological Sites and "Relics" and Burra Charter[2].

This report provides an assessment to identify proposed impacts to any built structures to determine the most appropriate management strategy. The assessment has been completed in accordance with the Conservation Management Plan (CMP) for the site.

1.5.1 Documentary investigation

Documents investigated include primary archival sources such as historic maps, plans and photographs, and newspapers. Secondary sources, including published and unpublished works, have been used to provide the historical context in this report. Information has been acquired from repositories including:

- NSW Land and Property Information.
- Heritage Division Library.
- Specialist technical reports.

Internet sources were also searched and include:

- Digitised Newspapers within Trove.
- The National Heritage List.
- The Commonwealth Heritage List.
- The State Heritage Register.
- The State Heritage Inventory.
- The Water NSW Heritage Register (s170 Register).
- The Australian Heritage Places Inventory.

[2] NSW Heritage Office 2001; Heritage Branch, Dept. of Planning 2009 and Australia ICOMOS Burra Charter 2013 and associated guidelines

- Parish Maps.

1.5.2 Site investigation

The site inspection involved pedestrian survey of the study area in order to understand the heritage character of existing heritage items, the field investigation also sought to more accurately determine the nature and extent of the archaeological resources. All built structures were inspected internally and externally and a photographic record was prepared.

1.5.3 Assessment objectives

The following is a summary of the major objectives of the assessment:

- Identify and assess the heritage values of the study area. The study aims to achieve this objective by:
  - Providing a brief summary of the principle historical influences that have contributed to creating the present-day built environment of the study area using resourses already available and some limited new research.
  - Identifying sites and features within the study area which are already recognised for their cultural heritage value through statutory and non-statutory heritage listings.
  - Preliminary identification of the cultural heritage significance of sites and features within the study area which are not recognised through statutory heritage listings.
  - Preliminary identification of known or potential archaeological sites within the study area.
- Assess the impact of the proposed works on the cultural heritage significance of the study area.
- Recommend measures to avoid or mitigate any negative impacts on the cultural heritage significance of the study area.

1.6 Investigators and contributors

This report was prepared by James Cole, Archaeologist at Biosis Pty Ltd. This report has been reviewed by Alexander Beben, Principal Archaeologist at Biosis Pty Ltd.

1.7 Limitations of the report

This report is based on historical research and field inspections. It is possible that further historical research or the emergence of new historical sources may support different interpretations of the evidence in this report.

Although this report was undertaken to best archaeological practice and its conclusions are based on professional opinion, it does not warrant that there is no possibility that additional archaeological material will be located in subsequent works on the site. This is because limitations in historical documentation and archaeological methods make it difficult to accurately predict what is under the ground.

The significance assessment made in this report is a combination of both facts and interpretation of those facts in accordance with a standard set of assessment criteria. It is possible that another professional may interpret the historical facts and physical evidence in a different way.

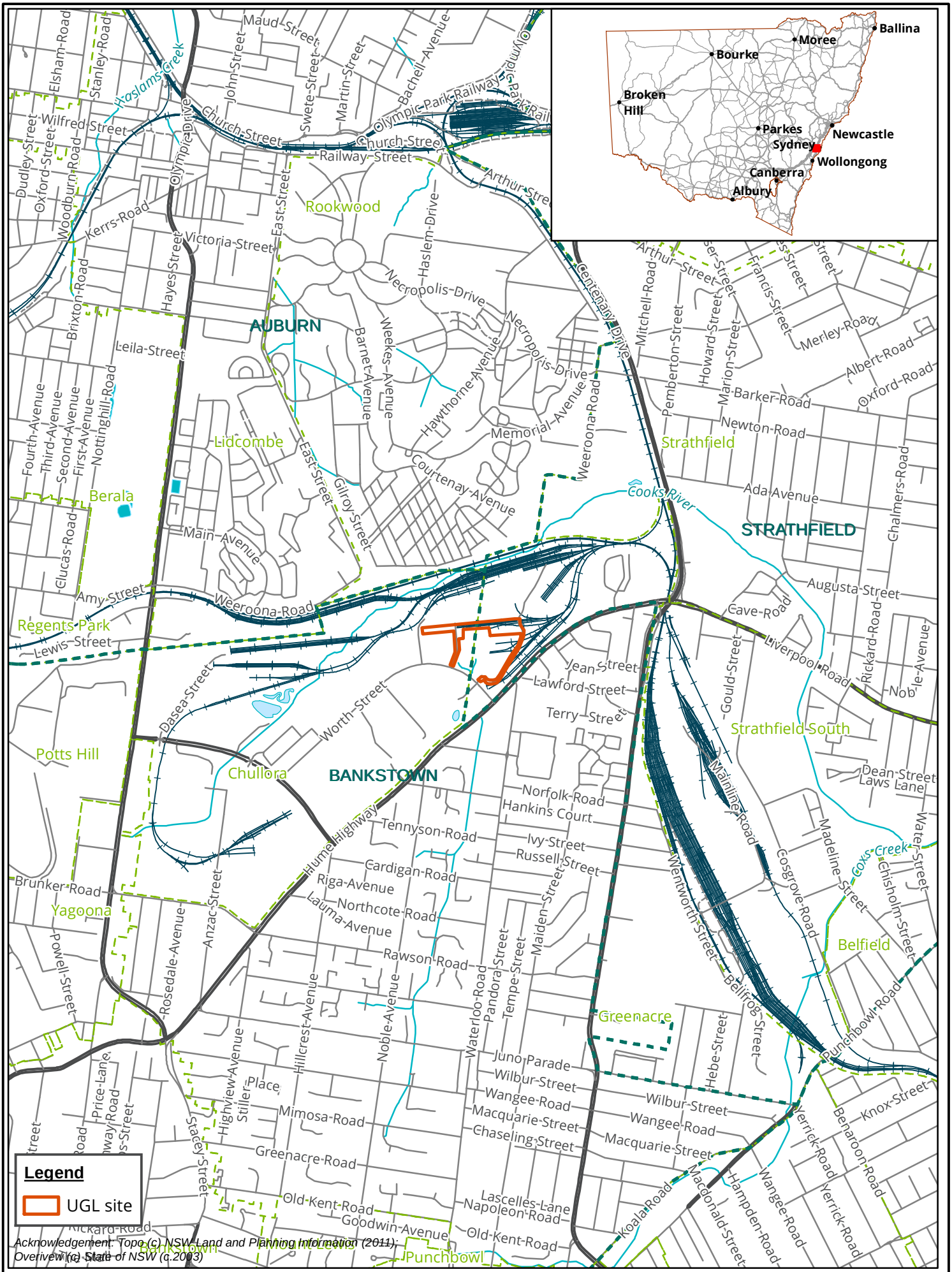

Figure 1: Location of the study area

Biosis Pty Ltd
Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

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Date: 14 December 2016,
Checked by: JAC, Drawn by: LH, Last edited by: lharley
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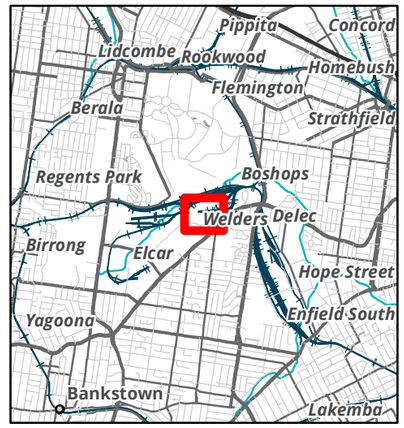

Legend

Study area

UGL site

Parcel boundary

Acknowledgements: Imagery © Nearmap 2016; Basemap © Land and Property Information 2016

Figure 2: Study area detail

0 20 40 60 80 100

Metres

Scale: 1:2,000 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 23183
Date: 15 December 2016,
Checked by: JAC, Drawn by: LH, Last edited by: lharley
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23183_F2_StudyArea

2 Site context

2.1 Introduction

The study area has previously been subject to a number of extensive assessments, most notably those conducted by Godden Mackay Pty Ltd,[3] and Austral Archaeology Pty Ltd.[4] This assessment will provide information relevant to the areas which will be impacted by the proposed works in order to give the reader a better understanding of the context and significance of items in these areas. For a more extensive history of the site as a whole, refer to the reports referenced in the development of this assessment.

2.2 Development of the Chullora Railway Workshops

The current study area includes only a portion of the former Chullora Railway Workshops, which previously extended further to the west and south along the Hume Highway. Much of this area has been sold off and redeveloped in recent decades, losing much of its heritage value. The original impetus for a railway workshop in Chullora (or the 'Rookwood District') came in the early 1900s. The railway industry had experienced rapid growth at the end of the 19th and early 20th centuries, and the Eveleigh Workshops (originally built in 1885 at Redfern) were poorly situated to accommodate the increasing demand associated with this, as their location constrained further expansion and development.

In addition to this the industry was at the start of a shift from steam to electric propulsion, which necessitated an overhaul in rail infrastructure. It was concluded that a new set of workshops would be required in Sydney to lessen the demand on the Eveleigh Workshops. In 1913, the site at Chullora was selected by the Minister for Works.[5]

The planned works were put on hold as a result of the outset of World War I, but works were approved in 1920 by Edward Ernest Lucy, Chief Mechanical Engineer. In 1923, a Royal Commission of Enquiry into the Railway and Tramway Services was established, recommending that activities undertaken at the Eveleigh Workshops be moved to Chullora, including the Electric Car workshop, with construction on this completed around 1926. This meant that Chullora was outfitted to service the suburban electric trains introduced in 1926.[6]

The Chullora Railway Workshops at this time consisted of three complexes in total, the Boiler Shop, the Signal Workshop, and the Electric Car Workshop. The Boiler Shop commenced operations in 1929, after the installation of the relevant machinery, and by 1932, boiler repair works from Eveleigh and Honeysuckle had transferred there as well.

The outbreak of World War II led to the conversion of the Chullora Railway Workshops for military uses. The Locomotive Workshop was converted for use in aircraft manufacture, with an Aircraft Annex being constructed at its eastern end, and the Tank Annex was built to be used for the assembly of cruiser tanks.[7] The Boiler Shop continued in its function throughout the war, however works were also undertaken there in aid of the war effort, including the punching out of base plates for use in artillery shells.[8]

[3] Godden Mackay Pty Ltd 1990
[4] Austral Archaeology Pty Ltd 2012
[5] Longworth J 2009
[6] Austral Archaeology 2012, p. 14
[7] Longworth 2009
[8] Austral Archaeology 2012, p. 18

After the end of World War II, the workshops returned to being used for railway purposes, being continually upgraded to meet the demands of new technology, as demonstrated with the introduction of diesel-electric locomotives in the late 1950s. The Boiler Shop was gradually altered from its use as a facility for the repair and construction of steam engine related boilers to a diesel locomotive repair shop, located in the Boiler Shop Annex.

Works at the Chullora Railway Workshops reached their peak in 1959, with the latter half of the 20th century characterised by progressive workshop closures and sale to private owners, along with modernisation of the remaining workshops to suit the needs of the day. In the mid 1980s, the workshops were divided into four maintenance centres as described below. These included the:

> *Bogie Maintenance Centre (BMC) formerly the Boiler Shop, Diesel Engine Maintenance Centre (DEMC) formerly the Boiler House Annex, Electrical Maintenance Centre (EMC) formerly the Tank Annex, and the Locomotive Maintenance Centre (LMC) formerly the Locomotive Workshop*.[9]

2.3 UGL site

The area identified in Figure 2 as the UGL site contains a number of heritage items identified by the CMP for the Chullora Railway Workshops. These were primarily constructed over the early to mid 20th century and are listed in Table 1. These items are located within the 'Locomotive Workshop Precinct' curtilage as defined by the CMP for the workshops.

Table 1 Identified heritage items within the UGL site

Year Built	Name	CMP building no.	Heritage Significance
1927-38	Locomotive Workshop	20	High
1929-30	Locomotive Yard	46	High
1941-42	Tank Annex	22	High, Intrusive
c. 1940s-1950s	Avenue of Mature Trees	43	Moderate

2.3.1 Locomotive Workshop

The Locomotive Workshop forms the central part of the Locomotive Workshop Precinct. It is a large steel-framed building. Its original cladding was corrugated and galvanized sheeting, with concrete floors. The original roof was replaced in the 1980s, and the workshop typically maintains a saw tooth construction, although this is not consistent throughout as it has been progressively modified and added to.

The building has been subject to extensive alterations throughout its lifetime, particularly during World War II, when aircraft annexes were added on to the south and east. Other modifications have been related to the outfitting of the workshop to undertake work in line with new technologies introduced throughout the 20th century.

The entirety of the structure is considered to be of heritage significance, including the internal and external fabric of the structure which traces its phases of development over the 20th century.[10]

[9] Austral Archaeology 2012, p. 22
[10] Austral Archaeology 2012, Vol 2 pp. 152-173

2.3.2 Locomotive Yard

The Locomotive Yard was first established in 1928, and has included several rail tracks, a turntable, weighbridge, coal stage, and water column, as well as tracks extending to the south for the storage of locomotives. It is an important aspect of the complex, as it demonstrates the relationships and uses of several of the structures present on the site.

It is considered to have a high level of heritage significance for this reason, and because of its contribution to the setting of the complex. This type of item is also considered to be rare in NSW.[11]

2.3.3 Tank Annex

The Tank Annex was built between 1941 and 1942, and was primarily used for the construction of cruiser tanks and armoured vehicles during World War II. It is a large two bay structure with each bay measuring 152 metres by 21 metres. It is built on a steel frame with corrugated iron cladding and fibro cement sheeting.

After World War II, it was used sequentially as a steam locomotive tender shop, a diesel locomotive repair shop, a bogie and electrical workshop, and an electrical maintenance centre. At some point after World War II, a Wash Down Bay was installed on the northern side of the Tank Annex. No specific date is given for the construction of the bay, but in style it is notably different from the Tank Annex. This bay has been assessed as having intrusive significance, with the remainder of the structure having high significance.[12]

2.3.4 Avenue of Mature Trees

The Avenue of Mature Trees consists of two rows of trees along the southern side of the locomotive yard and the roadway adjacent to the Locomotive Workshop and Aircraft Annex. The trees are considered to contribute to the visual setting of the Aircraft Annex and were a part of a series of gardens constructed in the workshops in the 1940s in order to improve working conditions.

The item has been assessed as having moderate significance, as the trees have little heritage significance as an item, but contribute to the setting of the precinct and workshops.

2.4 Research themes

Contextual analysis is undertaken to place the history of a particular site within relevant historical contexts in order to gauge how typical or unique the history of a particular site actually is. This is usually ascertained by gaining an understanding of the history of a site in relation to the broad historical themes characterising Australia at the time. Such themes have been established by the Australian Heritage Commission and the NSW Heritage Office and are outlined in synoptic form in New South Wales Historical Themes, issued by the NSW Heritage Office (2001).

There are 38 State Historical Themes, which have been developed for New South Wales, as well as nine National Historical Themes. These broader themes are usually referred to when developing sub-themes for a local area to ensure they compliment the overall thematic framework for the broader region.

A review of the contextual history in conjunction with the CMP previously created for the Chullora Railway Workshops[13] has identified six historical themes which relate to the occupational history of the study area. These are summarised in Table 2.

[11] Austral Archaeology 2012, Vol 2 pp. 379-380
[12] Austral Archaeology 2012, Vol 2 pp. 201-210
[13] Austral Archaeology 2012

Table 2 Identified historical themes for the study area

Australian theme	New South Wales theme	Local (rail) theme	Examples
3. Economy – Developing local, regional and national economies	3.4 Industry – developing NSW industrial capacity	3.4.1 Railway workshops	The Chullora Workshops complex. Boiler Shop, Locomotive Workshops.
3. Economy – Developing local, regional and national economies	3.6 Technology – activities and processes associated with the knowledge or use of mechanical arts and applied sciences	3.6.1 Locomotive design and technological development	Manufacture and repair of boilers in Boiler Shop 1927, Prototype electric locomotive built at Chullora in 1952 first NSW Railway electric locomotive, 1959-60 Locomotive Workshop first diesel workshop established in NSW Railway for introduction of diesel-electric and electric locomotive, 1984-85 technology upgraded after introduction of XPT high-speed passenger trains in NSW.
3. Economy – Developing local, regional and national economies	3.8 Transport – moving of people and goods from one place to another, and systems for the provision of such movements	3.8.6 Transport of goods	Layout of site designed to accommodate goods trains from surrounding rail yards.
7. Governing	7.2 Defence - defending places from hostile takeover and occupation	7.2.2 Manufacturing defence equipment and munitions	Air raid shelters, blast proof walls, building of annexes in addition to and separately from railway workshops for production and assembly of Beaufort Bombers in the Aircraft Annex and Cruiser Tanks in the Tank Annex, 2000 men and women employed at workshops in 1944 on aircraft production.
8. Developing Australia's cultural life	8.3 Creative Endeavour – activities associated with the production and performance of literary, artistic, architectural and other imaginative or inventive works	8.3.1 Evolution of design in railway engineering and architecture	Boiler Shop and Power House buildings reflecting Victorian era industrial buildings evolving to change in building design for later buildings including Locomotive Workshops, Aircraft Annex and Tank Annex.
		8.3.2 Railway gardens	Boiler Shop East Garden, Boiler Shop Annex Garden incl. Bowling Green as well as the Two Avenues of Mature Trees located within the Locomotive Workshops.
9. Phases of Life – Marking the phases of life	9.2 Persons – activities of, and associations with, identifiable individuals, families and communal groups	9.2.1 Significant railway identities	Associations with Chief Mechanical Engineer, Ernest Edward Lucy; Reginald Winsor, the Commissioner of Railways.

Heritage items within the study area are shown in Figure 3. Please note that there are a number of items within the boundaries of the study area that will not be impacted by the proposed works. These items include the Aircraft Annex (East) (item 21.2), Admin Building (Demolished) (item 32) Cafeteria (Demolished (item 33), First Aid Building (item 47), and Locomotive Workshop Gardens (East and West) (feature 50).

Acknowledgements: Imagery © Nearmap 2016; Basemap © Land and Property Information 2016

Legend

Study area

- UGL site

Heritage items

- 16 - Office Building
- 17 -Training Room
- 18 - Locomotives Stores Building (Igloo)
- 19 - Stores Building
- 20 - Locomotive Workshop
- 21.2 - Aircraft Annex (East)
- 22 - Tank Annex
- 32 - Admin Building (Demolished)
- 33 - Cafeteria (Demolished)
- 47 - First Aid Building
- F39 - Bowling Green
- F43 - Avenue of Mature Trees (Adjacent to Loco Yard)
- F46 - Loco Yard
- F50 - Locomotive Workshop Gardens (East and West)

Figure 3: Location of heritage items within the study area

0 20 40 60 80 100

Metres

Scale: 1:1,800 @ A3

Coordinate System: GDA 1994 MGA Zone 56

N

Biosis Pty Ltd

Ballarat, Brisbane, Canberra, Melbourne, Newcastle, Sydney, Wangaratta & Wollongong

Matter: 23183
Date: 14 December 2016,
Checked by: JAC, Drawn by: LH, Last edited by: lharley
Location:P:\23100s\23183\Mapping
23183_F3_Heritage

3 Physical analysis

3.1 Introduction

A field inspection of the study area was undertaken on 6 September 2016, attended by Alexander Beben, Principal Archaeologist, and James Cole, Archaeologist, of Biosis Pty Ltd. The principal aims of the survey were to identify which heritage items have the potential to be impacted by the proposed works, to conduct an external inspection of the known heritage items on site to determine their current condition, and to identify any previously unrecorded heritage items which may be present.

3.2 Site setting

The study area consists of one portion of the wider Chullora Railway Workshops (Figure 2). The 'UGL site' is located to the north, west, and south of the Locomotive Workshop in the southern portion of the study area (Plate 1). The study area has seen extensive use throughout the 20th century as a railway workshop, and also for a limited time during World War II for military purposes such as the manufacture of aircraft and tanks.

Plate 1 General view of the UGL site from the Locomotive Yard, view west (1 metre scale)

3.3 Built environment

The UGL site contains a large number of heritage items which may be impacted by the proposed works, including the Locomotive Workshop, the Locomotive Yard, the Tank Annex, and the Avenue of Mature Trees. All structures were inspected externally, and all appeared to be in good condition, consistent with the site inspection undertaken for the CMP.

The Locomotive Yard (Plate 2) will be utilised as a part of the new development. The only scheduled impacts to the Locomotive Yard will be the use of some rail racks for locomotive transportation, and the filling in of the remaining tracks with sand so that they do not present a Work, Health and Safety (WHS) risk. Neither of these impacts involves the destruction of the Locomotive Yard.

The Locomotive Workshop (Plate 2, Plate 3) and Tank Annex (Plate 4) will not be subjected to any impacts by the proposed works. The Avenue of Mature Trees (Plate 5) are also not scheduled to be impacted by the proposed works, however discussions on site noted that the works may involve the widening and upgrade of the adjacent road. If this is to occur, the trees should be safeguarded from removal to protect the setting of the site (Figure 4).

Plate 2 Locomotive Yard, view east

Plate 3 Detail of the Locomotive Workshop, view east

Plate 4 Detail of the Tank Annex, view west

Plate 5 View of the Avenue of Mature Trees, view south-west

The site inspection confirmed the current condition of all heritage items which may be impacted by the proposed works, and did not identify any new heritage items. Based on the scope of works provided to Biosis, and discussions held on site and after the field investigation, it was determined that the proposed works will impact the Locomotive Yard, and has the potential to impact the Avenue of Mature Trees.

In addition to this, the proposed works will take place adjacent to the Locomotive Workshop and potentially through a wing on the northern side of the Tank Annex which has been listed as being intrusive, or detrimental to the overall significance of the structure, however these works will not impact on the items.

4 Assessment of Significance

An assessment of heritage significance encompasses a range of heritage criteria and values. The heritage values of a site or place are broadly defined as the 'aesthetic, historic, scientific or social values for past, present or future generations'.[14] This means a place can have different levels of heritage value and significance to different groups of people.

4.1 Statement of significance

Section 2 of this assessment established that the study area is listed as the Chullora Railway Workshops. The workshops have been assessed in the past and are registered on the TfNSW s 170 with a detailed statement of significance. This assessment has not revealed any historical or archaeological information which alters the significance of this item. Consequently, it is not necessary to re-assess its significance; however the statement of significance is presented below as it appears in the CMP.

4.1.1 Statement of significance – Chullora Railway Workshops

The current Chullora Railway Workshops is considered to be of State significance because it is the sole surviving specialist workshop of the once expansive former Chullora Railway Workshops, which in its heyday covered some 200 hectares and comprised 3 major branches made up of 10 individual specialist workshops. The Workshops complex is of significance because of its longevity and ongoing continuous use to the present day, its role as the main central 20th Century railway workshop in urban Sydney and the integrity and intactness of the main elements and landscape. The current Chullora Railway Workshops provides an understanding of the technical advances that have been made in locomotive manufacture and design in the 20th Century in NSW as well as the social aspects of employment in a large government-owned State enterprise. The site is also of significance because of its role as a major manufacturing and assembly plant for aircraft and tanks in the Second World War and significant evidence of this function survives in the study area. The current Chullora Railway Workshops has rarity value as an urban railway workshop still in operation from the 1920s with intact evidence of its layout and all phases of its operations including the infrastructure from the Second World War. The current Chullora Railway Workshops is significant because it exhibits all the principal characteristics of railway workshops designed in the early 20th Century which has been adapted to accommodate changes in manufacturing technology and work practices through to the present day.

4.2 Evaluation of elements which comprise the study area

The background research and site survey for the project concluded that no reassessment of significance was necessary for any of the structures within the study area. As such, the assessment of significance for each item has been reproduced below as it appears in the CMP (Table 3).[15]

[15] Austral Archaeology 2012

Table 3 Statements of siginificance for CMP items which may be impacted by or are adjacent to the proposed works

CMP no.	Item	Level of significance	Statement of significance
UGL site			
20	Locomotive Workshop	High	The building is of technological significance as it demonstrates the best of workshop technology of its time in the layout and integration of features such as the traverser and in the provision of an extensive all-inclusive facility. The building is also significant in demonstrating the change in technology at the former Chullora Railway Workshops from steam locomotion to diesel. The current Chullora Railway Workshops was the first diesel workshop established in the NSW railway system. The building is an important example of large-scale 20th Century industrial structure. The building is likely to be of social significance to the thousands of railway workers who were employed there and who took great pride in their achievements in the maintenance and repair of locomotives. The building is located within the Locomotive Workshop Gardens which are of aesthetic significance.
22	Tank Annex	High	The Tank Annex is considered to have heritage significance due to its historic use during World War II for the assembly and production of parts for the Cruiser Tanks and armoured vehicles. It is of historical significance for its demonstration of wartime building techniques. The Tank Annex is also of representative significance as an example of an industrial workshop from the World War II period. The building is an important example of a largescale 20th Century industrial structure. The Tank Annex contributes to the aesthetic significance of the industrial landscape at the current Chullora Railway Workshops and demonstrates the expansion of the site during the early to mid-1940s. The Tank Annex is of technological significance as it represents innovation shown during World War II to produce tanks during times of material shortages. Its subsequent adaptation to railway purposes after the war is also technologically significant.
43	Avenue of Mature Trees	Moderate	The Avenue of Mature Trees is considered to be of significance as part of the current Chullora Railway Workshops and for its long term relationship with the significant buildings, features and other gardens within the site as a complete setting. The Avenue of Mature Trees is of aesthetic significance as it contributes to the visual setting of the Aircraft Annex East and Locomotive Workshop which are of hard industrial character. Such a setting and relationship are rare in such industrial complexes.

CMP no.	Item	Level of significance	Statement of significance
46	Locomotive Yard	High	The Loco Yard is considered to be of historic significance as it is an important element in the overall functioning of the site that also included the Turntable (Feature 28), Weighbridge (Building 29) and Load Box (Building 30) and has been in continuous operation since 1928. The rail tracks in the Loco Yard also linked the Locomotive Workshop (and Traverser) to the other essential elements in the complex and the yard is a major contributor to the setting. The Loco Yard is representative of its type and is also now comparatively rare within the railway system in NSW.

5 Statutory framework

5.1 Introduction

The project is being assessed under Part 5 of the *Environmental Planning and Assessment Act 1979;* therefore this report has been prepared as part of a Review of Environmental Factors (REF) to assess the impact the project is likely to have on the environment. The planning instrument relevant to the project is the *State Environmental Planning Policy (Infrastructure) 2007* (Infrastructure SEPP). Under this planning instrument, approval for the project is obtained from the public authority responsible for the work.

Clause 14 of the Infrastructure SEPP identifies the process to be undertaken with respect to items of local significance. Heritage items listed on the heritage schedule of the LEP must be considered but approval from the relevant Council is not required. However, impacts which are not considered minor or inconsequential to heritage items must be assessed and the relevant Council provided with 21 days to comment.

5.2 Statutory framework

5.2.1 Heritage management in New South Wales

In NSW cultural heritage is managed in a three-tiered system: National, State and local. Certain sites and items may require management under all three systems or only under one or two. The following discussion aims to outline the various levels of protection and approvals required to make changes to cultural heritage in the state.

5.2.2 Environmental Protection and Biodiversity Conservation Act 1999

The *Environmental Protection and Biodiversity Act 1999* (EPBC Act) is the national Act protecting the natural and cultural environment. The EPBC Act is administered by the Department of Sustainability, Environment, Water, Population and Communities (DSEWPaC). The EPBC Act establishes two heritage lists for the management of the natural and cultural environment:

- The National Heritage List (NHL)

  Items listed on the NHL have been assessed to be of outstanding significance and define "critical moments in our development as a nation".[16]

- The Commonwealth Heritage List (CHL)

  Items listed on the CHL are natural and cultural heritage places that are on Commonwealth land, in Commonwealth waters or are owned or managed by the Commonwealth. A place or item on the CHL has been assessed as possessing "significant" heritage value.[17]

A search of the NHL and CHL did not yield any results within the study area.

5.2.3 NSW Heritage Act 1977

Heritage in New South Wales is principally protected by the *Heritage Act 1977* (as amended) which was passed for the purpose of conserving items of environmental heritage of NSW. Environmental heritage is broadly

[16] "About National Heritage" http://www.environment.gov.au/heritage/about/national/index.html
[17] "Commonwealth Heritage List Criteria" http://www.environment.gov.au/heritage/about/commonwealth/criteria.html

defined under Section 4 of the Heritage Act as consisting of the following items: *"those places, buildings, works, relics, moveable objects, and precincts, of State or Local heritage significance*". The Act is administered by the NSW Heritage Council, under delegation by the Heritage Division, Office of Environment and Heritage. The Heritage Act is designed to protect both known heritage items (such as standing structures) and items that may not be immediately obvious (such as potential archaeological remains or 'relics'). Different parts of the Heritage Act deal with different situations and types of heritage and the Act provides a number of mechanisms by which items and places of heritage significance may be protected.

The State Heritage Register

Protection of items of State significance is by nomination and listing on the State Heritage Register created under Part 3A of the *NSW Heritage Act 1977*. The Register came into effect on 2 April 1999. The Register was established under the *Heritage Amendment Act* 1998. It replaces the earlier system of Permanent Conservation Orders as a means for protecting items with State significance.

A permit under Section 60 of the *NSW Heritage Act 1977* is required for works on a site listed on the State Heritage Register, except for that work which complies with the conditions for exemptions to the requirement for obtaining a permit. Details of which minor works are exempted from the requirements to submit a Section 60 Application can be found in the Guideline "Standard Exemptions for Works requiring Heritage Council Approval". These exemptions came into force on 5 September 2008 and replace all previous exemptions.

In addition to this, there are rail-specific exemptions which exist under Section 57 of the *NSW Heritage Act 1977*, which allow for certain low-impact activities to take place within State Heritage Register (SHR) places without the need for a Section 60 approval or Section 57 exemption notification. The proposed works are not exempt.

A search of the SHR did not yield any results within the study area.

Archaeological relics

Section 139 of the Heritage Act protects archaeological 'relics' from being 'exposed, moved, damaged or destroyed' by the disturbance or excavation of land. This protection extends to the situation where a person has 'reasonable cause to suspect' that archaeological remains may be affected by the disturbance or excavation of the land. This section applies to all land in New South Wales that is not included on the State Heritage Register.

Amendments to the Heritage Act made in 2009 changed the definition of an archaeological 'relic' under the Act. A 'relic' is defined by the Heritage Act as:

> *"Any deposit, object or material evidence:*
>
> *(a) which relates to the settlement of the area that comprises New South Wales, not being Aboriginal settlement, and*
>
> *(b) which is of State or Local significance*

It should be noted that not all remains that would be considered archaeological are relics under the NSW Heritage Act. Advice given in the Archaeological Significance Assessment Guidelines is that a "relic" would be viewed as a chattel and it is stated that "*In practice, an important historical archaeological site will be likely to contain a range of different elements as vestiges and remnants of the past. Such sites will include 'relics' of significance in the form of deposits, artefacts, objects and usually also other material evidence from demolished buildings, works or former structures which provide evidence of prior occupations but may not be 'relics'.*" (2009: 7).

If a relic, including shipwrecks in NSW waters (that is rivers, harbours, lakes and enclosed bays) is located, the discoverer is required to notify the NSW Heritage Council.

Section 139 of the Heritage Act requires any person who knows or has reasonable cause to suspect that their proposed works will expose or disturb a 'relic' to first obtain an Excavation Permit from the Heritage Council of NSW (pursuant to Section 140 of the Act), unless there is an applicable exception (pursuant to Section 139(4)). Excavation permits are issued by the Heritage Council of New South Wales in accordance with sections 60 or 140 of the *Heritage Act*. It is an offence to disturb or excavate land to discover, expose or move a relic without obtaining a permit. Excavation permits are usually issued subject to a range of conditions. These conditions will relate to matters such as reporting requirements and artefact cataloguing, storage and curation.

Exceptions under Section 139(4) to the standard Section 140 process exist for applications that meet the appropriate criterion, however an application is still required to be made. The Section 139(4) permit is an exception from the requirement to obtain a Section 140 permit and reflects the nature of the impact and the significance of the relics or potential relics being impacted upon; however, archaeological relics are unlikely to be encountered during the course of the proposed works.

If an exception has been granted and, during the course of the development, substantial intact archaeological relics of State or local significance, not identified in the archaeological assessment or statement required by this exception, are unexpectedly discovered during excavation, work must cease in the affected area and the Heritage Office must be notified in writing in accordance with section 146 of the NSW *Heritage Act 1977*. Depending on the nature of the discovery, additional assessment and, possibly, an excavation permit may be required prior to the recommencement of excavation in the affected area.

Section 170 Heritage and Conservation Registers

Section 170 of the *Heritage Act* requires that culturally significant items or places managed or owned by Government agencies are listed on departmental Heritage and Conservation Register. Information on these registers has been prepared in accordance with Heritage Division guidelines.

Statutory obligations for archaeological sites that are listed on a Section 170 Register or may exist within the curtilage of an item include notification to the Heritage Council in addition to relics provision obligations.

A search of the TfNSW s170 register yielded one result within the study area.

- *Chullora Railway Workshops, TfNSW register # 4801108*

5.2.4 Environmental Planning and Assessment Act 1978

Local Environmental Plans

The Strathfield and Bankstown LEPs contain schedules of heritage items that are managed by the controls in the instrument. As the project is being undertaken under the State Environmental Planning Policy (Infrastructure) 2007 (ISEPP 2007), heritage items listed on the heritage schedule require a statement of heritage impact and notification to Council rather than approval if more than minor or inconsequential impacts occur. Relics are still protected by the *Heritage Act* and Aboriginal sites are protected by the *National Parks and Wildlife Act 1979* regardless of their status on an LEP or despite the fact that they are unregistered.

A search of the LEPs did not yield any results within the study area.

5.3 Non – statutory registers

5.3.1 National Trust of Australia

The National Trust of Australia is a community-based, non-government organisation, committed to promoting and conserving Australia's indigenous, natural and historic heritage through its advocacy work and its custodianship of heritage places and objects.

A search of the National Trust Register did not yield any results within the study area.

5.3.2 Register of National Estate

The Register of the National Estate (RNE) was originally established under the Australian Heritage Commission Act 1975 (repealed). The Register of the National Estate was closed in 2007 and is no longer a statutory list. All references to the Register of the National Estate were removed from the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) on 19 February 2012. However, the list remains an archive and an item that was once listed on the RNE may have been transferred to the NHL or the CHL. Listing on the RNE is an indication that the site or item has significance.

A search of the RNE did not yield any results within the study area.

6 Statement of Heritage Impact

6.1 Introduction

This SoHI has been prepared to address the proposed impacts to a number of buildings within the wider Chullora Railway Workshops precinct. The site is listed on the TfNSW s170 register, and has been identified by a number of studies as having heritage value.

The SoHI identifies the level of impact of the proposal and the steps taken to avoid or reduce those impacts. This section of the report has been prepared in accordance with the Heritage Manual *Statements of Heritage Impact.*[18]

6.2 Proposal details

The proposed works will have impacts within one areas of the site, described for the purposes of this assessment as the 'UGL site' (Figure 4).

6.2.1 UGL site

Proposed works within the UGL site involve its conversion for use as a VENM staging zone. This will involve the importation of VENM sandstone to the site by truck, and its transfer to trains.

Some of the key metrics relating to the works include:

- Outgoing sandstone VENM from the M4/M5 extractions sites transported by road to the Sydney Trains Chullora yard in Sydney.
- The trucks will tip to direct load train wagons.
- Should trains not be in place, a temporary surge pile with a capacity of 3,000 tonnes of material (one train load) is allowed for at Chullora.
- Three 3,000 tonnes (net payload) trains will transport the VENM to Port Kembla. This equates to 9,000 tonnes per day.
- Incoming VENM will be direct transferred from train to truck at the BlueScope Steel CRM yard at Port Kembla.

The proposed works in this area will have a direct impact on the Locomotive Yard, which has been identified as including items with a high level of significance, as well as having some potential to impact on the Avenue of Mature Trees.

6.2.2 Description of impacts

The proposed impacts which are likely to take place on each of the buildings and features of heritage significance are listed in Table 4.

[18] Heritage Office and Department of Urban Affairs & Planning 1996

Table 4 Proposed impacts to heritage items within the study area

Item	Impact
UGL site	
Locomotive Workshop	No impacts planned as a result of a project redesign.
Locomotive Yard	Some existing rails in the Locomotive Yard will be utilized for the transportation of VENM, the remaining rails will be filled in with sand to make safe the site and avoid impacts.
Tank Annex	No impacts planned as a result of a project redesign.
Avenue of Mature Trees	No impacts are currently planned. Pruning would permissible with additional consent from TfNSW.

6.3 Assessment of impacts

The discussion of impacts to heritage can be centred upon a series of questions which must be answered as part of a SoHI which frame the nature of impact to a heritage item. The Heritage Manual guideline *Statements of Heritage Impact* includes a series of questions that indicate the criterion which must be answered.[19] The questions for changes of use to a heritage item are applicable to the proposed development, these are:

- *Has the advice of a heritage consultant or structural engineer been sought? Has the consultant's advice been implemented? If not, why not?*
- *Does the existing use contribute to the significance of the heritage item?*
- *Why does the use need to be changed?*
- *What changes to the fabric are required as a result of the change of use?*
- *What changes to the site are required as a result of the change of use?*

In addition, the CMP sets out a number of conservation policies and requirements in order to conserve and manage the site in accordance with the Burra Charter; it also establishes the requirement for regular maintenance of the site and recommendations for new work to be in keeping with the character of the site. Specific conservation policies that are relevant to specific items are described in Table 5.

6.4 Discussion

The proposed works are unlikely to have a negative impact on the overall heritage significance of the Chullora Railway Workshops

The following sympathetic solutions have been considered and adopted for the following reasons:

The initial design of the project included impacts to the Locomotive Workshop which would have had a detrimental impact to its heritage significance, as it would have involved the removal of three additions from the structure, one of which dates to 1938 (numbered 3 in Plate 6), and the other two to after 1957 (numbered 1 and 2 in Plate 6). The removal of these additions would have detracted from the cultural significance of the Locomotive Workshop and the overall precinct. After discussions with Cardno, it was determined that the

[19] *ibid*

project footprint could be redesigned to avoid impacts to the locomotive workshop, preserving its fabric and heritage significance.

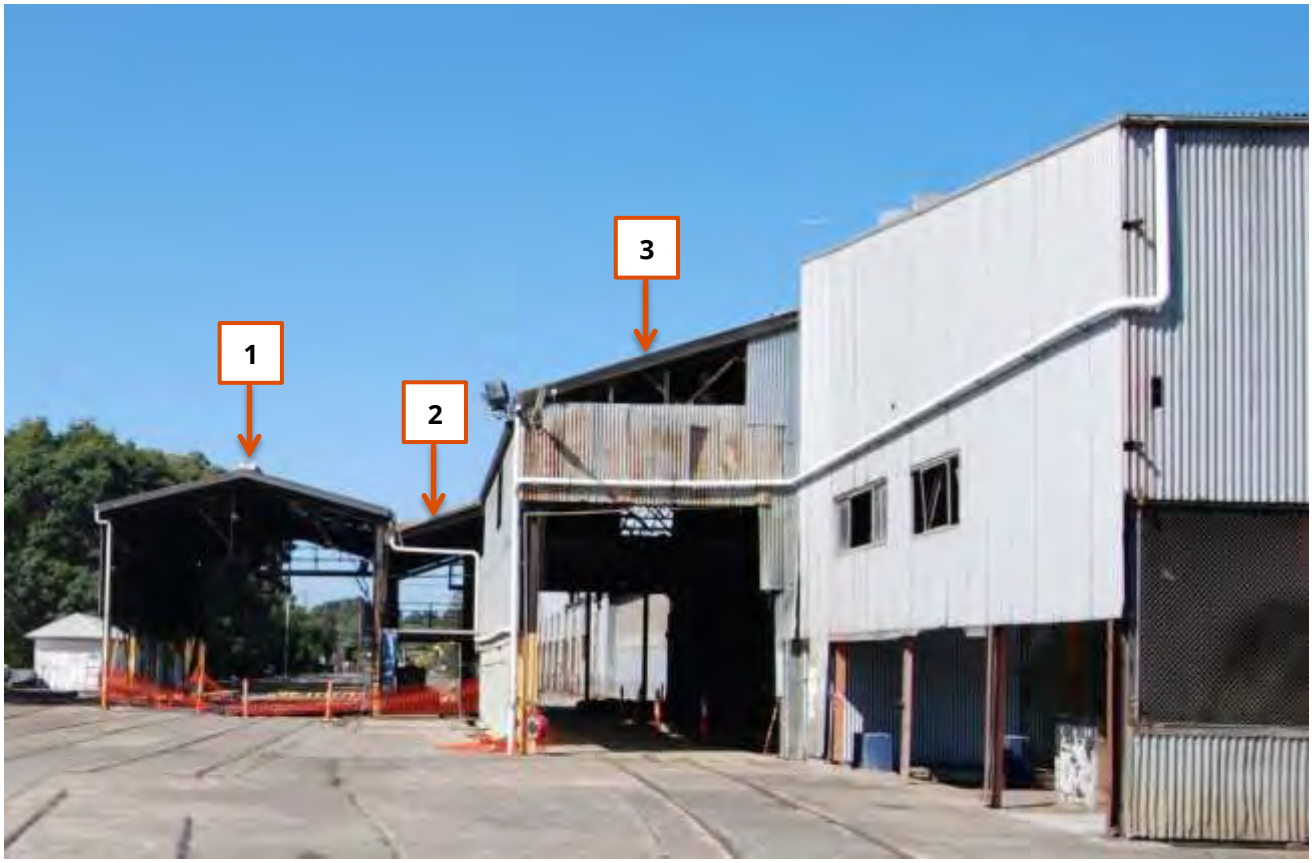

Plate 6 **Detail of the Locomotive Workshop annex which will be impacted by the proposed works, view east-south-east**

The following aspects of the proposal could detrimentally impact on heritage significance. The reasons are explained as well as the measures to be taken to minimize impacts:

Impacts to the Avenue of Mature Trees would negatively affect the heritage significance of the site, and it has therefore been recommended that impacts to the trees be avoided. It has been indicated that pruning of the trees may be required to facilitate the works, which would be in keeping with the site specific exemptions of the CMP relating to horticultural maintenance.

The following aspects of the proposal respect or enhance the heritage significance of the item or conservation area for the following reasons:

The proposed works may also enhance the heritage significance of the Chullora Railway Workshops. The works within the UGL site are in accordance with Policy 7 of the CMP, which states that it is desirable for the precinct to be used for railway and public transport related uses. Use of the site for inter-modal purposes (road to rail) would fall under this policy.

The use of the site for railway purposes would not only be in keeping with the CMP, but it would provide a tangible benefit for the portion of the site being used, providing an incentive to undertake regular maintenance on the site, and will lessen the likelihood of cumulative impacts which may occur if it is left vacant, such as to vandalism, looting, and deterioration of the fabric of the workshops.

Figure 4 Proposed works area at the UGL site

Table 5 Discussion of impacts in relation to the CMP policies and proposed mitigation measures

Item	Level of significance	Nature of impact	Relevant CMP policies and guidelines	Proposed mitigation measures	Acceptable impact?
UGL site					
Locomotive Yard	High	Compatible use	**Policy 7**: Any uses associated with railway operations are desirable and preferable to uses for other purposes, provided they do not detract from the cultural significance of the place and comply with the policies in the CMP. Other uses associated with public transportation (e.g. fabrication, assembly, storage, parking, maintenance) are also acceptable on the same conditions. **Policy 13**: Conserve significant features of the setting identified in this report. **Item specific policies:** **46.1** The Locomotive Yard should be retained. Policies 1 and 20 refer. **46.2** Continued use of the Locomotive Yard for railway purposes is encouraged. Adaptation to new uses should be carefully considered against the reuse policies. Policies 6, 7 and 8 refer. **46.3** The relationship of the Locomotive Yard to surrounding heritage items such as the Turntable (28), Weighbridge (29), Load Box (30), Locomotive Workshop and Aircraft Annexes (20, 21.1 and 21.2) must be maintained. Policy 13 refers. **46.4** The setting of the Locomotive Yard must be retained. This setting includes the associated elements such as the Turntable (28), Weighbridge (29), Load Box (30) and Locomotive Workshop and Aircraft Annexes (20, 21.1 and 21.2). Policy 13 refers.	**Archival Recording**. The proposed works will not have any impact on the fabric of the Locomotive Yard, and are in keeping with Policy 7 of the CMP by utilising the area for railway operations. Any unused tracks will be filled with sand to protect them from harm and minimize WHS risks in using the area. Such a measure can easily be reversed to return the yard to its original state. Nevertheless, it would be prudent to undertake an archival recording of the feature prior to the commencement of works, and to prepare an archival report.	Yes
Avenue of mature Trees	Moderate	Pruning	**Policy 13:** Conserve significant features of the setting identified in this report. **Policy 14:** Conserve the significant formal gardens and plantings. Landscaping should generally be confined to maintenance and preservation of the existing gardens, lawns and avenues of mature trees. Where new landscaping is desired or required, it should be constructed in a similar style to that of existing; species selection should reflect the range of species in evidence. **Item specific policies:** **43.1** The avenues of mature trees should be retained and maintained in their present form. Policies 13 and 14 refer. **43.2** If the trees show signs of stress they should be assessed by a qualified arborist. Policy 1 refers. **43.3** The trees should be replaced on a like-for-like basis as required or may be replaced with other plantings appropriate to the era on the advice of a suitably qualified garden historian or landscape architect. Policies 1 and 14 refer. **43.4** The avenues of trees would be suitable for interpretation as part of general interpretation about the gardens and worker's conditions at the site. Policy 35 refers.	**Avoidance.** Where possible, impacts to the Avenue of Mature Trees should be avoided to preserve them in their current setting. **Pruning.** It may be necessary to prune back the trees in order to make the area usable. Such an impact is accounted for in the site specific exemptions section of the CMP, which makes allowance for 'Horticultural maintenance including lawn mowing, cultivation, pruning, fertilising, aerating, and remedial tree surgery.' As such, no further assessment would be required prior to pruning.	Yes

6.5 Statement of Heritage Impact

The proposed works are unlikely to have a negative impact on the overall heritage significance of the Chullora Railway Workshops. Within the UGL site it is proposed to use the Locomotive Yard as a VENM staging zone. The use of the Locomotive Yard is in keeping with the CMP, and it will suffer no impacts to its fabric or layout as a result of the proposed works. All reasonable efforts have been made to avoid impacts to key elements of the precinct and preserve the heritage significance of the workshops and to ensure that the Locomotive Yard can be returned to its original state. Use of the Locomotive Yard for railway-related purposes has the potential to positively enhance its heritage significance.

A summary of the proposed impacts, management and mitigation measures, and how these measures relate to the CMP is provided in Table 5.

7 Conclusion and recommendations

7.1 Conclusions

The proposed works involve impacts to a number of features within the Chullora Railway Workshops. All items have previously been assessed, and a CMP developed for the workshops. This assessment has identified that all proposed works are in accordance with the CMP and have the potential to positively impact the site by utilising the area for inter-modal purposes (road to rail), which are a railway related use.

Provided that the recommendations are adopted for the project as well as any additional conditions of approval, the project may proceed with minimal loss of significance.

7.2 Next steps

In order for the proposed works to progress at the UGL site, the proponent should engage a heritage consultant to complete an archival recording of all heritage items which will be impacted prior to works being undertaken. Items to be recorded include the Locomotive Yard. Such a measure would satisfy Policy 23 of the CMP:

> ***Policy 23:*** *The impact of proposed changes on the cultural significance of a building or the study area will be assessed via a statement of heritage impact, except where the change would fall within a standard or site specific exemption. If necessary the proposed change will be modified to better retain cultural significance. Adequate archival recording may be required before any changes are made to the place. The process of assessing and managing change will be supervised by a suitably qualified heritage professional.*

Given that the proposed works involve a change of use to a highly significant feature of the overall site, it would be prudent to undertake archival recording of the item prior to the proposed works taking place. This recording would act as a record of the Locomotive Yard in its current context, prior to the change of use, and allow it to be reinstated back to its original condition if it is no longer required for intermodal uses in the future. In addition to this, it will act as a record if the proposed change of use has any unforeseen permanent impacts on the item.

7.3 Recommendations

These recommendations have been formulated to respond to client requirements and the significance of the site. They are guided by the ICOMOS *Burra Charter* with the aim of doing as much as necessary to care for the place and make it useable and as little as possible to retain its cultural significance.[20]

Recommendation 1: The project may proceed with conditions

Based on the assessment made in this report, it is considered that the proposed development represents an acceptable impact on the Chullora Railway Yards, provided that the following mitigation measures are adopted.

[20] "The Burra Charter 1999", The Australia ICOMOS Charter of Places of Cultural Significance.

Recommendation 2: Prepare an archival record prior to impacts, during construction and at the completion of the project

Given the nature of the works, it is recommended that an archival recording be undertaken for the Locomotive Yard. Ensure that the archival record is prepared in accordance with the Heritage Branch guidelines *How to Prepare Archival Records for Heritage Items* and *Photographic Recording of Heritage Items Using Film or Digital Capture* (Heritage Office 2001, revised 2004, 2006).

Recommendation 3: Avenue of Mature Trees to remain

Avoid impacts to the Avenue of Mature Trees to preserve them in their current setting. Pruning of the trees is acceptable under the CMP if required, however additional approval would be required from TfNSW.

Recommendation 4: Prohibited works

No works or activities are to occur outside of the UGL site as defined in Figure 2 of this report, or which may impact on heritage items which have not been assessed by this report without prior consultation with a heritage specialist regarding the potential impacts of this work.

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Appendix 6 – Assessment of Ecology Constraints

Rod Barber
Sydney Trains
C/O Daniel Thompson
Cardno
E: daniel.thompson@cardno.com.au

22 January 2016

Re: Assessment of Environmental Constraints, Chullora Rail yard, Chullora

Dear Daniel,

This report has been prepared for Cardno, on behalf of, Transport for NSW (TfNSW). Please find below the summary of observations and recommendations made during a site visit carried out on 8 September 2016, and follow up visit on 24 November 2016, at Chullora Rail yard, Chullora (Lot 3 // DP 1102984).

Background and purpose of report

Initial site assessment was undertaken for the proposed development of a stockpile area in the western portion (Site C) of Chullora Rail Yard, Chullora (**Figure 1**). Development was to include vegetation clearing within Site C as well as the extension of an existing railway line located just east of Site C. Given this assessment identified significant ecological constraints, additional assessment of a site further to the east (Site D) was undertaken (**Figure 2**).

This report provides the results of these assessments with respect to the ecological value of the vegetation and fauna habitats within both Site C and Site D, providing an assessment of the potential for threatened species, populations and ecological communities to be impacted by the proposal. Further, it identifies ecological constraints associated with the proposed action, and provides an offsets calculation for proposed clearing associated with Site C.

The recommendations of this report identify the preferred location for the proposal and highlight mitigation measures to minimise potential impacts on environmental values.

Methods and results

Desktop literature review – Atlas of NSW Wildlife

Threatened species, populations and migratory species recorded within 5 km of the Site C and Site D (the locality) in a search of the Atlas of NSW Wildlife (OEH 2016a) were consolidated and their likelihood of occurrence was assessed by:

- review of location and date of recent (<5 years) and historical (>5-20 years) records
- review of available habitat within Site C and Site D and surrounding areas
- review of the scientific literature pertaining to each species and population
- applying expert knowledge of each species

The potential for each threatened species, population and/or migratory species to occur was then considered following review of available habitat within the study area. The potential for species to utilise the site and to be affected directly or indirectly by the proposed action were considered as either:

- "Recent record" = species has been recorded in the study area within the past 5 years
- "High" = species has previously been recorded in the study area (>5 years ago) or in close proximity (for mobile species), and/or habitat is present that is likely to be utilised by a local population
- "Moderate" = suitable habitat for a species is present onsite but no evidence of a species detected and relatively high number of recent records (5-20 years) in the locality or species is highly mobile
- "Low" = suitable habitat for a species is present onsite but limited or highly degraded, no evidence of a species detected and relatively low number of recent records in the locality
- "Not present" – suitable habitat for the species is not present onsite or adequate survey has determined species does not occur in the study area

Thirty-three threatened species were recorded within a 5 km radius of Site C and Site D, twenty-three fauna (fourteen migratory) and ten flora (**Figure 3**). The nearest 'recent record' of threatened fauna species to Site C and Site D is *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat), listed as 'vulnerable' under the NSW *Threatened Species Conservation Act 1995* (TSC Act). The nearest 'recent records' of a threatened flora species to Site C and Site D is *Wahlenbergia multicaulis* (Tadgell's Bluebell) listed as an 'endangered population' under the TSC Act. It is located approximately 100 m north of Site C and Site D. No threatened species have been identified within Site C and Site D within the past twenty years.

Desktop review – regional scale vegetation mapping (OEH 2013)

Regional-scale vegetation mapping by OEH (2013) has classified the majority of the vegetation in Site C as 'Castlereagh Ironbark Forest' (S_DSF01), with a small portion being classified as 'Urban Native and Exotic Cover'. Castlereagh Ironbark Forest is a component of the threatened ecological community Cooks River/Castlereagh Ironbark Forest, listed as 'endangered' under the TSC Act and 'critically endangered' under the EPBC Act (**Figure 4**). Within close proximity to Site C and Site D there are patches of Cumberland Riverflat Forest (S_FOW06). Cumberland River-Flat Forest is a component of the plant community type River-Flat Eucalypt Forest on Coastal Floodplains, which is listed as an Endangered Ecological Community under the TSC Act. A small amount of Castlereagh Ironbark Forest has been mapped at Site D (**Figure 5**).

Desktop review – Flora and Fauna Preliminary Assessment (ELA 2015)

Eco Logical Australia (ELA) conducted a preliminary Flora and Fauna Assessment at Site C, which identified the dominant vegetation community as Cooks River/Castlereagh Ironbark Forest. Note that this assessment did not include Site D. ELA calculated that the proposed development would require the removal of 1.27 ha of the vegetation community, which represents 68.65% of the patch within Site C. Through an Assessment of Significance under Section 5A of the NSW *Environmental Planning and Assessment Act 1979* (EP&A Act), ELA concluded that the proposal is likely to have a significant impact the Cooks River/Castlereagh Ironbark Forest Endangered Ecological Community and therefore a Species Impact Statement would be required. Additionally, an Assessment of Significance under the EPBC Act concluded that a referral to the Commonwealth is recommended due to potential significant impact on Cooks River/Castlereagh Ironbark Forest Critically Endangered Ecological Community.

Although no threatened flora and fauna were detected during the brief surveys undertaken by ELA, it was determined that Site C provided potential habitat for several threatened species. This included three flora species *Acacia pubescens* (Downy Wattle), *Pomaderris prunifolia* (Plum-leaf Pomaderris) and *Wahlenbergia multicaulis* (Tadgell's Bluebell) and five fauna species *Litoria aurea* (Green and Golden Bell Frog), *Pteropus poliocephalus* (Grey-headed Flying Fox), *Falsistrellus tasmaniensis* (Eastern False Pipistrelle), *Mormopterus norfolkensis* (Eastern Freetail-bat) and *Miniopterus schreibersii oceanensis* (Eastern Bentwing-bat). ELA concluded that if the proposal were to move forward targeted surveys would need to be conducted to determine the presence or absence of these species.

Desktop review – Draft Management Plan for the Green and Golden Bell Frog Key Population at Greenacre (DECC 2007)

The Greenacre population is one of 43 key Green and Golden Bell Frog populations identified as populations on which conservation efforts should be focused upon. The Greenacre population consists of three subpopulations: Juno Parade former brick pit site, Old Enfield Marshalling Yards and Cox's Creek Reserve.

Within the Draft Management Plan the Chullora Railway Workshops Site has been identified as an area where Green and Golden Bell Frogs have previously existed and which currently has strategic potential as Green and Golden Bell Frog habitat. In the 1990's during various re-developments in the Greenacre area the Green and Golden Bell Frog was not only identified at the Chullora Railway site but at numerous other sites.

The Management plan suggests that sites such as the Chullora Railway site, which have been identified as potential Green and Golden Bell Frog habitat should be used to reconnect the Greenacre population with other key populations nearby. This would involve potential reintroductions to sites such as the Chullora Railway Site.

Field survey – vegetation

A general site survey (Hnatiuk et al. 2009) was conducted by Darren James (Senior Consultant) and James Schlunke (Ecologist) on 8 September 2016. A second survey was conducted by Gary Leonard (Senior Botanist) on 24 November 2016. Each survey assessed the vegetation and fauna habitat features on site and classified the vegetation.

The first survey undertook two BioMetric survey plots for the purposes of calculating potential offsets (see **Photos 1** and **2**). The surrounding immediate vegetation and community structure was also observed to assess the vegetation within its local context.

Site C: Site inspection confirmed the presence of 1.13 ha of Cooks River/Castlereagh Ironbark Forest at Site C, which is further classified into the Plant Community Type classification (OEH 2016) as Broad-leaved Ironbark – Melaleuca decora shrubby open forest (**Figure 6**). This Plant Community Type classification is used to calculate offsets under the BioBanking Assessment Methodology (BBAM) (OEH 2014).

Site D: Most of the vegetation in Site D consists of planted trees and shrubs, either growing in strips of grassland or in garden beds and containers. Most vegetation patches consist of narrow bands, following existing roads and paths. Common tree species include introduced and non-endemic natives, *Lophostemon confertus** (Brush Box), *Eucalyptus microcorys** (Tallowwood), *Populus nigra** 'Italica' (Poplar) and *Platanus x hispanica** 'Acerifolia' (London Plane). The planted groups include self-recruited specimens including *Melia azedarach* (White Cedar), *Celtis sinensis** (Hackberry) and *Pittosporum undulatum* (Brush Daphne). Invasive species which have been planted include *Acacia saligna** (Golden Wreath Wattle), *Philostachys (?) bambusoides** (Bamboo), *Corymbia citriodora** (Lemon-scented Gum) and *Corymbia torelliana** (Cadaghi). Ground-cover is variable and mostly includes a range of exotic grasses and forbs. The most commonly occurring indigenous grass is *Chloris truncata* (Windmill Grass).

Two threatened plant species occur, three specimens of *Eucalyptus scoparia** (Wallangarra White Gum) and one specimen of *Eucalyptus nicholii** (New England Black Peppermint), although both species are not indigenous to Sydney and do not require further impact assessment.

A small patch of Cooks River/Castlereagh Ironbark Forest regrowth occurs on a batter in the north-western corner of Site D, which is likely to have self-recruited from propagules from the adjacent patch of vegetation at Site C. It is likely that this patch has recently developed, as there are no mature or over-mature trees and there is several pioneer species, including, *Acacia falcata* (Sickle Wattle), *Bursaria spinosa* subsp. *spinosa* (Blackthorn) and the invasive *Acacia saligna**. The most common canopy species is *Melaleuca nodosa* (Prickly-leaved Paperbark), with occasional occurrences of *M. decora* and one individual of *Eucalyptus fibrosa* (Red Ironbark). These specimens mostly occur near the fence, and native midstorey species are uncommon, but include *Dillwynia sieberi, Lissanthe strigosa* subsp. *strigosa* (Peach Heath) and *Kunzea ambigua* (Tick Bush). The most common native grass species is *Themeda triandra* (Kangaroo Grass), especially on vegetation edges at the eastern portion of the top of the batter. Other grass species include *Microlaena stipoides* var. *stipoides* (Weeping Grass), *Aristida ramosa* var. *ramosa* (Purple Wiregrass) and *Eragrostis brownii* (Browns Lovegrass). Common exotic mid-storey species include *Lantana camara** (Lantana) and *Baccharis halimifolia** (Groundsel Bush).

No indigenous threatened flora species were recorded during the field survey. All species identified from the field survey are listed in Table 1.

Field survey – fauna habitat

Site C: Fauna habitat at Site C includes open forested vegetation, small water bodies and industrial waste, which have the potential to provide roosting and foraging habitat for several fauna guilds (**Photo 3**). Most of the threatened fauna recorded in close proximity to Site C

are highly mobile species and may potentially forage at Site C from time to time, but are unlikely to rely on it as there sole foraging area.

Site C has previously been identified as potential Green and Golden Bell Frog habitat (DECC 2007) with several small-vegetated water bodies existing on site. Survey of the Site C validated the presence of this habitat as seen in **Figure 7**.

There have been historic recordings of the Green and Golden Bell Frog (*Litoria aurea*) from within the Chullora Railway site in the early to mid-1990s (DECC 2007) and there is one Atlas record (OEH 2016) from 1965 from approximately 500m west of Site C. Aside from these early recordings no known surveys have been conducted within Site C.

The closest current population of the Green and Golden Bell Frog is located approximately 3 km to the south east of Site C and is known as the Greenacre key population. Although there haven't been any Green and Golden Bell frogs identified within Site C during the past twenty years there is a potential for the frogs to disperse to the site via the Cooks River, which is located just 200m to the west.

Site D: Fauna habitat at this site is limited, but may provide refugia for birds, lizards, amphibians and ground-dwelling mammals. Whilst the occurrence of the Green and Golden Bell Frog is uncertain in the Chullora Railyard, if the species is present migration and refuge habitat may be utilised within Site D for short periods. Similar habitat is present throughout the broader precinct.

Avoidance, mitigation and offsetting

Site C: Initial site assessment of Site C identified the presence of 1.13 ha of the Plant Community Type Broad-leaved Ironbark - Melaleuca decora shrubby open forest on clay soils of the Cumberland Plain, Sydney Basin Bioregion, which is associated with Cooks River/Castlereagh Ironbark Forest Threatened Ecological Community. As the proposal was unable to avoid impacts to this vegetation, 'significant impacts' are likely and further assessment under NSW EP&A Act would be necessary in the form of a Species Impact Statement (SIS) or a Biobanking Statement. An offset calculation using the BioBanking Assessment Methodology found that the proposed development would require 47 ecosystem credits of this Plant Community Type. Additionally, a referral to the Commonwealth is recommended under the EPBC Act.

Further, survey identified the potential habitat for Green and Golden Bell Frog, which is listed as 'endangered' under the TSC Act and 'vulnerable' under the EPBC Act. Additionally, the species is a 'species credit' species, if using the BioBanking Assessment Methodology. As such, a targeted survey would be necessary for this species.

Site D: Given the vegetation at this site is predominantly planted, with only a small patch of regenerating Threatened Ecological Community, this site is a more appropriate location for development, as impacts to Threatened Ecological Community and fauna habitat will only be minor. If appropriate avoidance and mitigation measures are in place there is no potential for 'significant impacts' at Site D, and offsetting would not be required. These avoidance and mitigation measures would include the following:

- To ensure TfNSW replants all trees that would be removed in accordance with their internal policy, a pre-clearance survey by an ecologist of the final boundary is recommended. The survey would measure the size of all trees to be removed and would recommend appropriate species and locations for plantings.
- The design of the final boundary should include modelling to avoid direct or indirect impact to the Threatened Ecological Community in the north-west of Site D.
- Preparation of an Environmental Construction Management Plan (CEMP) which would include:
    - Appropriate Erosion and Sedimentation Control Plan prepared in accordance with Landcom (2004) and implemented prior to construction.
    - Mitigation measures to avoid weed and propagule spread, hours of operation including noise restrictions, and measures to avoid light spill into retained vegetation.
    - Details of the pre-clearance protocols including avoidance measures and planting plan.

Conclusions and recommendations

Due to the presence of Cooks River/ Castlereagh Ironbark Forest Endangered Ecological Community within Site C along with potential Green and Golden Bell Frog habitat, the proposed action is likely to constitute a significant impact in accordance with s5A of EP&A Act and the EPBC Act. As such, further assessment in the form of a Species Impact Statement or Biobanking Statement and a referral to the Commonwealth would be necessary. *Given the much lower ecological constraints it is recommended that TfNSW consider developing Site D rather than Site C*.

If you would like to discuss any of the above comments and recommendations further, please contact me on the below details.

Sincerely,

Lucas McKinnon

Director and Principal Ecologist
Accredited Biobanking Assessor (Acc# 76)
BEnvSc (Hons), GCert. Ornith. | M: 0421 603 549 | E: lucas.mckinnon@ecoplanning.com.au

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Figure 1: Site C, Chullora Rail Yard, Chullora.

Figure 2: Site D, Chullora Rail Yard, Chullora.

Figure 3: Threatened species recorded in desktop literature review.

Figure 4: Regional scale vegetation mapping at Site C (OEH, 2013).

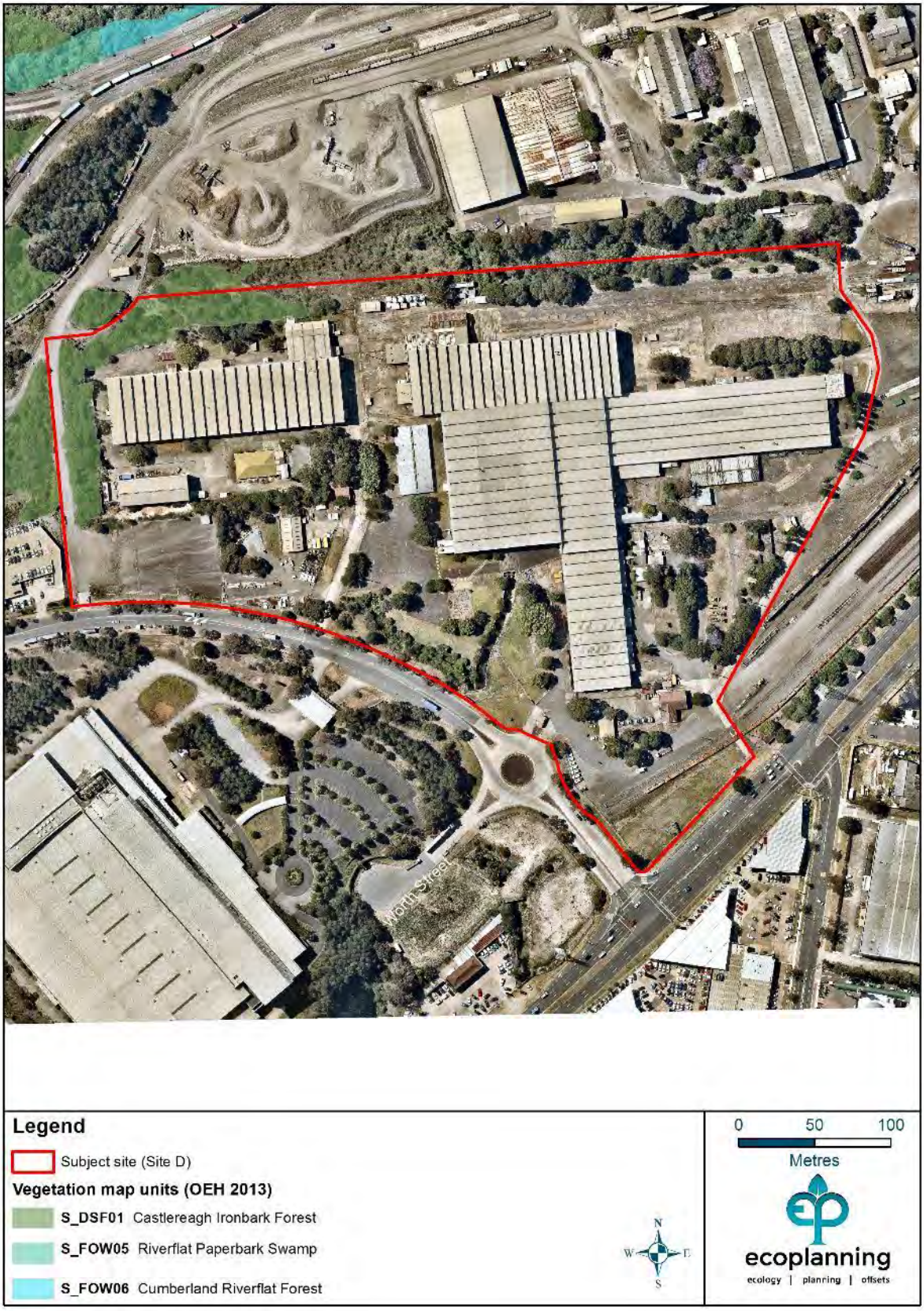

Figure 5: Regional scale vegetation mapping at Site D (OEH, 2013).

Figure 6:Validated vegetation communities and position of biobanking plots at Site C (Ecoplanning 2016).

Figure 7: Validated Green and Golden Bell Frog habitat within Site C.

Figure 8: Field validated vegetation at Site D (Ecoplanning 2016).

Table 1: Flora species inventory

Family	*Genus*	*species*	Common name	Native/ Exotic	Site C				Site D	
					BBP1	BBP1	BBP2	BBP2		
					C	A	C	A	CRCIF	Planted
Amaranthaceae	*Amaranthus*	*retroflexus*	Red-root Amaranth	Exotic						o
Anacardiaceae	*Harpephyllum*	*caffrum*	Kaffir Plum	Exotic						o
Apiaceae	*Foeniculum*	*vulgare*	Fennel	Exotic					o	o
Apocynaceae	*Gomphocarpus*	*fruticosus*	Narrow-leafed Cotton Bush	Exotic					u	u
	Nerium	*oleander*	Oleander	Exotic						o
Asclepiadaceae	*Araujia*	*sericifera*	Moth Vine	Exotic					u	u
Asparagaceae	*Asparagus*	*aethiopicus*	Ground Asparagus	Native			<1	5	u	u
	Asparagus	*asparagoides*	Bridal Creeper	Exotic	<1	1	1	10	u	u
	Asparagus	*officinalis*		Exotic			<1	1		
Asteraceae	*Aster*	*subulatus*	Spear Thistle	Exotic	<1	1			u	
	Baccharis	*halimifolia*	Groundsel	Exotic						
	Bidens	*pilosa*	Cobblers Pegs	Exotic			<1	5	o	o
	Cassinia	*aculeata*	Dolly Bush	Native	4	70	1	5	u	
	Chrysanthemoides	*monilifera*	Bitou Bush	Exotic			2	20		
	Conyza	*sumatrensis*	Tall Fleabane	Exotic					u	u
	Conyza	*spp.*		Exotic	<1	3				
	Coreopsis	*lanceolata*	Coreopsis	Exotic	1	100				
	Gamochaeta	*spp.*		Exotic	<1	20				
	Hypochaeris	*microcephala*	White Flatweed	Exotic			<1	1		
	Hypochaeris	*radicata*	Cat's Ear	Exotic						u
	Lactuca	*serriola*	Prickly Lettuce	Exotic						o
	Ozothamnus	*diosmifolius*	White Dogwood	Native					u	

Family	*Genus*	*species*	Common name	Native/ Exotic	Site C				Site D	
					BBP1	BBP1	BBP2	BBP2		
					C	A	C	A	CRCIF	Planted
	Senecio	*madagascariensis*	Fireweed	Exotic	<1	5	<1	2		
	Sonchus	*oleraceus*	Common Sowthistle	Exotic	<1	3	<1	3	u	u
Basellaceae	*Anredera*	*cordifolia*	Madeira Vine	Exotic					u	
Campanulaceae	*Wahlenbergia*	*communis*	Tufted Bluebell	Native			<1	10	u	
Caryophyllaceae	*Cerastium*	*fontanum*	Mouse-ear Chickweed	Exotic						u
Casuarinaceae	*Allocasuarina*	*diminuta subsp. mimica*		Native	1	4				
	Casuarina	*glauca*	Swamp Oak	Native					o	c
Chenopodiaceae	*Chenopodium*	*album*	Fat Hen	Exotic						u
	Einadia	*hastata*	Berry Saltbush	Native					u	u
	Einadia	*nutans*	Climbing Saltbush	Native			<1	2		
	Einadia	*nutans* subsp *nutans*	Climbing Saltbush	Native					u	
Commelinaceae	*Commelina*	*cyanea*	Scurvy Weed	Native					u	
	Tradescantia	*fluminensis*	Wandering Jew	Exotic					u	u
Convolvulaceae	*Dichondra*	*repens*	Kidney Weed	Native					u	u
Cupressaceae	*Platycladus*	*orientalis*	Bookleaf Cypress	Exotic						o
Cyperaceae	*Cyperus*	*brevifolius*	Mullumbimby Couch	Native						u
	Cyperus	*eragrostis*	Umbrella Sedge	Exotic						u
	Cyperus	*gracilis*	Slender Flat-sedge	Native					u	
	Lepidosperma	*laterale*		Native			4	500		
Ericaceae - Epacridoideae	*Astroloma*	*humifusum*	Native Cranberry	Native	<1	3	<1	3	u	
	Leucopogon	*juniperinus*	Prickly Beard-heath	Native	<1	3	3	23		
	Lissanthe	*strigosa*	Peach Heath	Native			8	120	u	

Family	*Genus*	*species*	Common name	Native/ Exotic	Site C				Site D	
					BBP1	BBP1	BBP2	BBP2		
					C	A	C	A	CRCIF	Planted
Fabaceae - Faboideae	*Dillwynia*	*parvifolia*		Native	2	25	2	100		
	Dillwynia	*sieberi*		Native			<1	2	u	
	Glycine	*clandestina*	Glycine	Native			<1	3	u	
	Glycine	*microphylla*	Small-leaf glycine	Native			<1	2		
	Hardenbergia	*violacea*	Purple Coral Pea	Native			<1	2		
	Medicago	*polymorpha*	Burr Medic	Exotic						u
	Pultenaea	*linophylla*		Native			<1	1		
	Pultenaea	*microphylla*		Native	15	1000	3	55		
	Trifolium	*subterraneum*	Subterranean Clover	Exotic						u
Fabaceae - Mimosoideae	*Acacia*	*brownii*	Prickly Moses	Native			<1	3		
	Acacia	*decurrens*	Early Green Wattle	Native					u	u
	Acacia	*falcata*	Hickory wattle	Native			<1	1	o	o
	Acacia	*longifolia subsp. longifolia*	Sydney Golden Wattle	Native	2	3	2	6		
	Acacia	*parramattensis*	Paramatta Wattle	Native	2	2			u	
	Acacia	*saligna*	Golden Wreath Wattle	Exotic					c	c
Gentianaceae	*Centaurium*	*minus*	Pink Stars	Exotic						u
Goodeniaceae	*Goodenia*	*hederacea subsp. hederacea*	Forest Goodenia	Native	<1	10	2	50		
Haloragaceae	*Gonocarpus*	*teucrioides*	Raspwort	Native					u	
Iridaceae	*Romulea*	*longifolia*	Guildford Grass	Exotic						u
Juncaceae	*Juncus*	*usitatus*	Common Rush	Native						u
Lamiaceae	*Prunella*	*vulgaris*	Self Heal	Exotic						u
Lauraceae	*Cassytha*	*glabella*		Native			3	100		

Family	*Genus*	*species*	Common name	Native/ Exotic	Site C				Site D	
					BBP1	BBP1	BBP2	BBP2		
					C	A	C	A	CRCIF	Planted
Linaceae	*Linum*	*trigynum*	French Flax	Exotic	<1	50				
Lobeliaceae	*Pratia*	*purpurascens*	Whiteroot	Native			<1	20		
Lomandraceae	*Lomandra*	*cylindrica*	Needle Mat-rush	Native			2	500		
	Lomandra	*filiformis subsp. coriacea*		Native			5	>1000		
	Lomandra	*filiformis subsp. filiformis*	Wattle Mat-rush	Native			3	500		
	Lomandra	*multiflora*	Many-flowered Mat-rush	Native			3	500		
	Lomandra	*multiflora* subsp. *multiflora*	Many-flowered Mat-rush	Native					u	
Malaceae	*Cotoneaster*	*pannosus*	Cottoneaster	Exotic						u
Malvaceae sens lat.	*Malva*	*parviflora*	Mallow	Exotic						u
	Sida	*rhombifolia*	Paddy's Lucerne	Exotic					u	u
Meliaceae	*Melia*	*azedarach*	White Cedar	Native					o	o
Myrsinaceae	*Anagallis*	*arvensis*	Blue Pimpernel	Exotic						u
Myrtaceae	*Angophora*	*costata*	Smooth-barked Apple	Native	<1	1				u
	Angophora	*floribunda*	Rough-barked Apple	Native					u	u
	Callistemon	*citrinus*	Red Bottlebrush	Native						u
	Callistemon	Kings Park Special		Exotic						u
	Callistemon	*linearis*	Narrow-leaved Bottlebrush	Native			<1	1		
	Callistemon	*viminalis*	Weeping Bottlebrush	Exotic						o
	Corymbia	*citriodora*	Lemon-scented Gum	Exotic						o

Family	*Genus*	*species*	Common name	Native/ Exotic	Site C				Site D	
					BBP1	BBP1	BBP2	BBP2		
					C	A	C	A	CRCIF	Planted
	Corymbia	*citriodora* x *maculata* hybrid							u	u
	Corymbia	*torelliana*	Gadaghi	Exotic						o
	Eucalyptus	*botryoides*	Bangalay	Native						u
	Eucalyptus	*fibrosa*	Red Ironbark	Native			15	2	u	
	Eucalyptus	*microcorys*	Tallow wood	Exotic						c
	Eucalyptus	*nicholii*	Black Peppermint	Exotic						u
	Eucalyptus	*pilularis*	Blackbutt	Native						u
	Eucalyptus	*robusta*	Swamp Mahogany	Native						u
	Eucalyptus	*saligna* x *botryoides* hybrid	Sydney Blue-Gum Hybrid	Native					u	u
	Eucalyptus	*scoparia*	Wallangarra White Gum	Exotic						u
	Kunzea	*ambigua*	Tick Bush	Native	2	15	3	21	u	
	Lophostemon	*confertus*	Brushbox	Exotic						c
	Melaleuca	*decora*	Ridge Paperbark	Native					o	
	Melaleuca	*nodosa*	Prickly-leaved Paperbark	Native			6	20	o	
	Melaleuca	*sieberi*		Native	6	32	6	14		
Ochnaceae	*Ochna*	*serrulata*	Mickey Mouse Plant	Exotic			<1	2		
Oleaceae	*Ligustrum*	*lucidum*	Large-leaf Privet	Exotic					u	u
	Ligustrum	*sinense*	Small-leaf Privet	Exotic					u	u
	Notelaea	*longifolia*	Large Mock-olive	Native			<1	2		
Ophioglossaceae	*Ophioglossum*	*spp.*		Native	<1	3				
Orchidaceae	*Caladenia*	*carnea*	Pink Fairy	Native			<1	1		

Family	*Genus*	*species*	Common name	Native/ Exotic	Site C				Site D	
					BBP1	BBP1	BBP2	BBP2		
					C	A	C	A	CRCIF	Planted
	Diuris	*spp.*		Native	<1	1				
	Thelymitra	*spp.*		Native	<1	5				
Oxalidaceae	*Oxalis*	*perennans*		Native			1	50		
Phormiaceae	*Dianella*	*longifolia*	Blueberry Lily	Native	<1	1				
	Dianella	*revoluta*	Blueberry Lily	Native	<1	10	2	100		
Phyllanthaceae	*Poranthera*	*microphylla*		Native			<1	10		
Pittosporaceae	*Billardiera*	*scandens*	Hairy Apple Berry	Native					u	
Plantaginaceae	*Plantago*	lanceolata	Plantain	Exotic						o
Platanaceae	*Platanus*	x *hispanica* 'Acerfolia'	London Plane	Exotic						o
Pittosporaceae	*Bursaria*	*spinosa*	Blackthorn	Native	<1	3	<1	3		
	Bursaria	*spinosa* var *spinosa*	Blackthorn	Native					o	u
	Pittosporum	*undulatum*	Native Daphne	Native			21	4		u
Poaceae	*Andropogon*	*virginicus*	Whisky Grass	Exotic	1	20				u
	Aristida	*ramosa*	Purple Wiregrass	Native			1	20		
	Aristida	*ramose* var. *ramosa*	Purple Wiregrass	Native					o	
	Aristida	*vagans*	Threeawn Speargrass	Native			2	100		
	Avena	*barbata*	Bearded Oats	Exotic						o
	Axonopus	*fissifolius*	Carpet Grass	Exotic						o
	Bromus	*catharticus*	Bromegrass	Exotic						o
	Chloris	*truncata*	Windmill Grass	Native					o	o
	Chloris	*gayana*	Rhodes Grass	Exotic						u
	Cortaderia	*selloana*	Pampas Grass	Exotic	<1	10				

Family	*Genus*	*species*	Common name	Native/ Exotic	Site C				Site D	
					BBP1	BBP1	BBP2	BBP2		
					C	A	C	A	CRCIF	Planted
	Cymbopogon	*refractus*	Barbed Wire Grass	Native			<1	10		
	Cynodon	*dactylon*	Couch	Native	1	50			o	c
	Digitaria	*ciliaris*	Summer Grass	Exotic						u
	Echinopogon	*caespitosus*	Bushy Hedgehog-grass	Native			<1	10		
	Ehrharta	*erecta*	Panic Veldtgrass	Exotic			<1	7	u	u
	Ehrharta	*longiflora*	Annual Veldtgrass	Exotic			<1	1		
	Entolasia	*stricta*	Wiry Panic	Native			4	500		
	Eragrostis	*brownii*	Brown's Lovegrass	Native	2	500	1	50	u	u
	Eragrostis	*curvula*	African Lovegrass	Exotic	25	>1000				
	Lolium	*perenne*	Perennial Rye	Exotic						u
	Melinis	*repens*	Red Natal Grass	Exotic						u
	Microlaena	*stipoides* var. *stipoides*	Weeping Grass	Native			4	1000	o	u
	Paspalidium	*distans*		Native			5	>1000		
	Paspalum	*dilatatum*	Paspalum	Exotic	1	20	<1	3		u
	Pennisetum	*clandestinum*	Kikuyu	Exotic						o
	Philostachys (?)	*bambusoides*	Bamboo							o
	Rytidosperma	*racemosum*		Native	<1	2	<1	2		
	Rytidosperma	*setaceum*	Smallflower Wallaby Grass	Native			<1	2		
	Rytidosperma	*tenuis*	Wallaby Grass	Native					u	
	Setaria	*parviflora*		Exotic	<1	5				
	Setaria	*pumila*	Pale Pigeon Grass	Exotic					u	u
	Themeda	*triandra*	Kangaroo Grass	Native			1	20		

Family	*Genus*	*species*	Common name	Native/ Exotic	Site C				Site D	
					BBP1	BBP1	BBP2	BBP2		
					C	A	C	A	CRCIF	Planted
Polygalaceae	*Polygala*	*virgata*		Exotic	<1	5			o	
Polygonaceae	*polygonum*	*avivulare*	Wireweed	Exotic						u
Primulaceae	*Anagallis*	*arvensis*	Scarlet Pimpernel	Exotic						u
Proteaceae	*Hakea*	*sericea*	Needlebush	Native	3	30	1	5		
Pteridaceae	*Cheilanthes*	*sieberi* subsp. *sieberi*	Mulga Fern	Native	<1	4	3	1000	u	
Rubiaceae	*Galium*	*aparine*	Goosegrass	Exotic			<1	1		
	Opercularia	*diphylla*		Native	<1	2	4	20		
	Pomax	*umbellata*		Native					u	
Salicaceae	*Populus*	*nigra* 'Italica'	Lombardy Poplar	Exotic						o
Santalaceae	*Exocarpos*	*cupressiformis*	Cherry Ballart	Native	1	1	4	10		
Solanaceae	*Solanum*	*nigrum*	Deadly Nightshade	Exotic					u	u
Stackhousiaceae	*Stackhousia*	*viminea*		Native			<1	10		
Ulmaceae	*Celtis*	*sinensis*	Hackberry	Exotic						o
Verbenaceae	*Lantana*	*camara*	Lantana	Exotic			4	20	o	o
	Verbena	*bonariensis*	Purple Top	Exotic						u
	Verbena	*rigida*	Purple Top	Exotic						u

*Not indigenous to Strathfield LGA (see James, McDougall and Benson 1999); C Cosmopolitan species; Plant species of conservation significance

Photo 1: Broad-leaved Ironbark – Melaleuca decora shrubby open forest, mature regeneration at Site C.

Photo 2: Broad-leaved Ironbark – Melaleuca decora shrubby open forest, early regeneration at Site C.

Photo 3: Green and Golden Bell Frog habitat at Site C.

Appendix 7 – Air Quality Assessment

Report

Spoil Management Pathway – Air Quality Impact Assessment

Document Control Number: AQU-NW-001-21681C

Date: 20 January 2017

Pacific Environment Limited

Technologies Consulting Monitoring

www.pacific-environment.com

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Document Control Number:	AQU-NW-001-21681C
Prepared For:	Cardno
Approved For Release By:	Judith Cox
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Table of contents

List of Figures

List of Tables

1. Introduction

Transport for NSW (TfNSW) is reviewing the viability of transporting spoil from large infrastructure projects within the Sydney Metropolitan Area south to the Illawarra Region by train (the Project). The Project would involve the transfer of spoil material from sites (including the M4 and M5 road projects) to Chullora Rail Yards (the Chullora Site) by truck and placing the material on trains for transport to BlueScope Commonwealth Rolling Mills site (the CRM Site) in Port Kembla. This report has been prepared as part of a Review of Environmental Factors (REF) to assess potential air quality impacts from site operations at the Chullora Railyards and Port Kembla CRM sites.

1.1 Scope of Work

Pacific Environment have been commissioned to undertake the following scope of work:

- A review of proposed activities and air emission potential for the Project
- A quantitative assessment of potential air quality impacts associated with Project operations at the CRM site including:
    - Analysis of existing air quality.
    - Preparation of an emission inventory for the operational phase of the Project.
    - Preparation of a site-specific meteorological dataset.
    - Dispersion modelling of operational emissions.
    - Assessment against regulatory air quality criteria.
- A qualitative assessment of potential air quality impacts associated with construction operations.
- A qualitative assessment of potential air quality impacts associated with Project operations at the Chullora site.
- Discussion of recommended mitigation and management measures.

The methodology and findings of this work are outlined in this report.

1.2 Project Description

The Project will establish an integrated transport path for the transfer of Virgin Excavated Natural Material (VENM) from the M4/M5 excavations, to civil construction projects in the Illawarra Region.

The Project will see:

- Outgoing sandstone VENM from the M4/M5 extractions sites transported by road to the Sydney Trains Chullora yard in Sydney.
- The trucks will tip the VENM to direct load train wagons.
- Should trains not be in place, a temporary surge pile with a capacity of 3,000 tonnes of material (one train load) is allowed for at Chullora.
- Three 3,000 tonnes (net payload) trains will transport the VENM to Port Kembla. This equates to 9,000 tonnes per day.
- Incoming VENM will be direct transferred from train to truck at the BlueScope Steel CRM yard at Port Kembla.

The proposed rail movements would be scheduled within the existing freight timetable and would not require additional network capacity.

The total number of truck movements (one-way) per day into the site will be 255. This will be undertaken in three campaigns per day to coincide with train arrivals, i.e.:

- Early Morning – 85 truck movements
- Lunchtime – 85 truck movements
- Late Afternoon – 85 truck movements

There will likely be 14 trucks in the fleet, working 3 x 3 hour shifts.

Spoil Material

The spoil material would consist of sandstone (~65%) and mixed sandstone / siltstone / shale (~35%) possessing the following size distribution:

- < 50 mm: ~80%
- 50 - 150 mm: ~15%
- 150 – 250 mm: ~5%

Whilst the material would not be wet, it would possess a moisture content generally consistent with rock that has been excavated from below the water table, and wetted during handling

A conceptual plant layout is presented in Figure 1.1 and Figure 1.2 for each site (respectively).

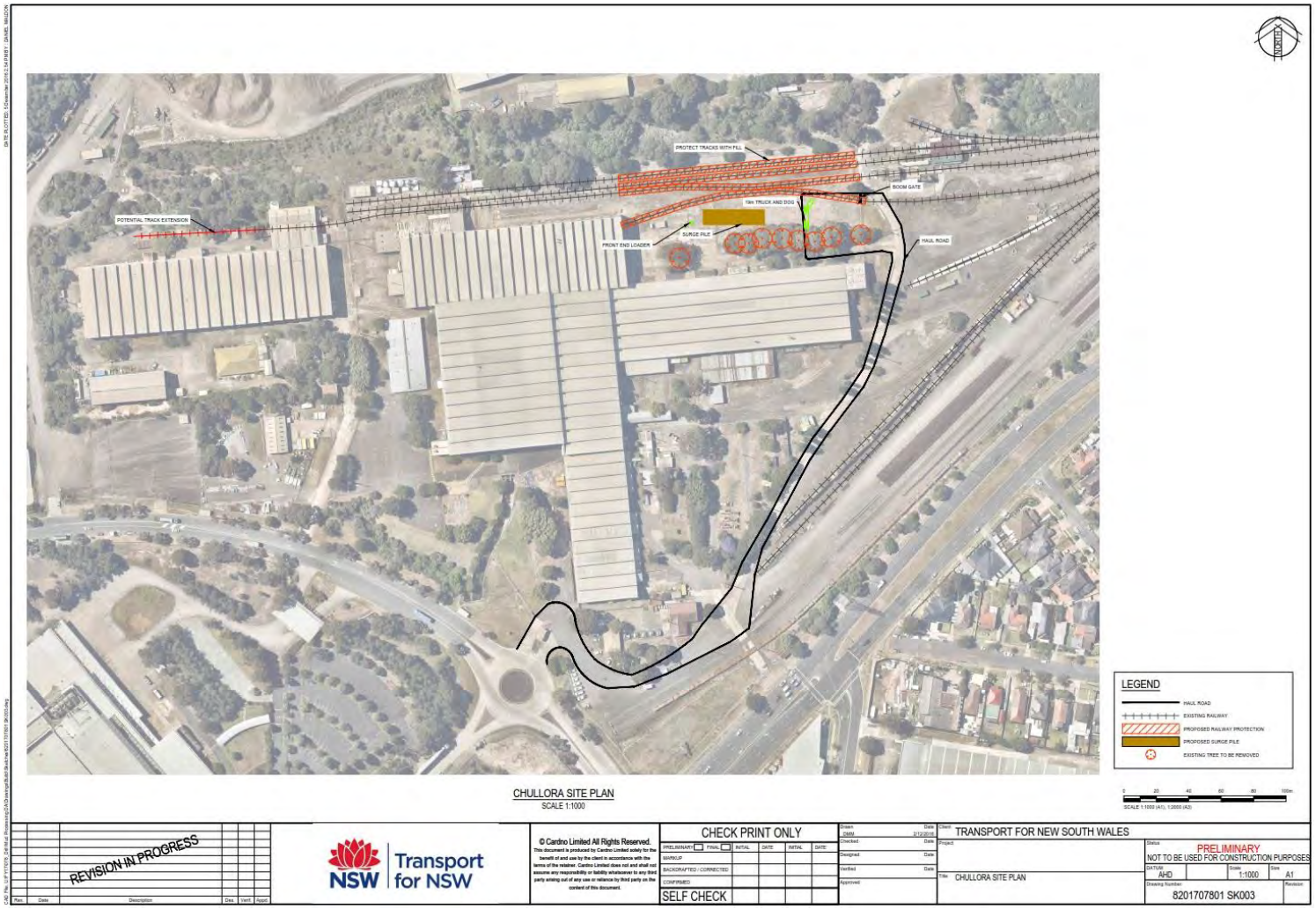


Figure 1.1 Concept Layout - Chullora Site

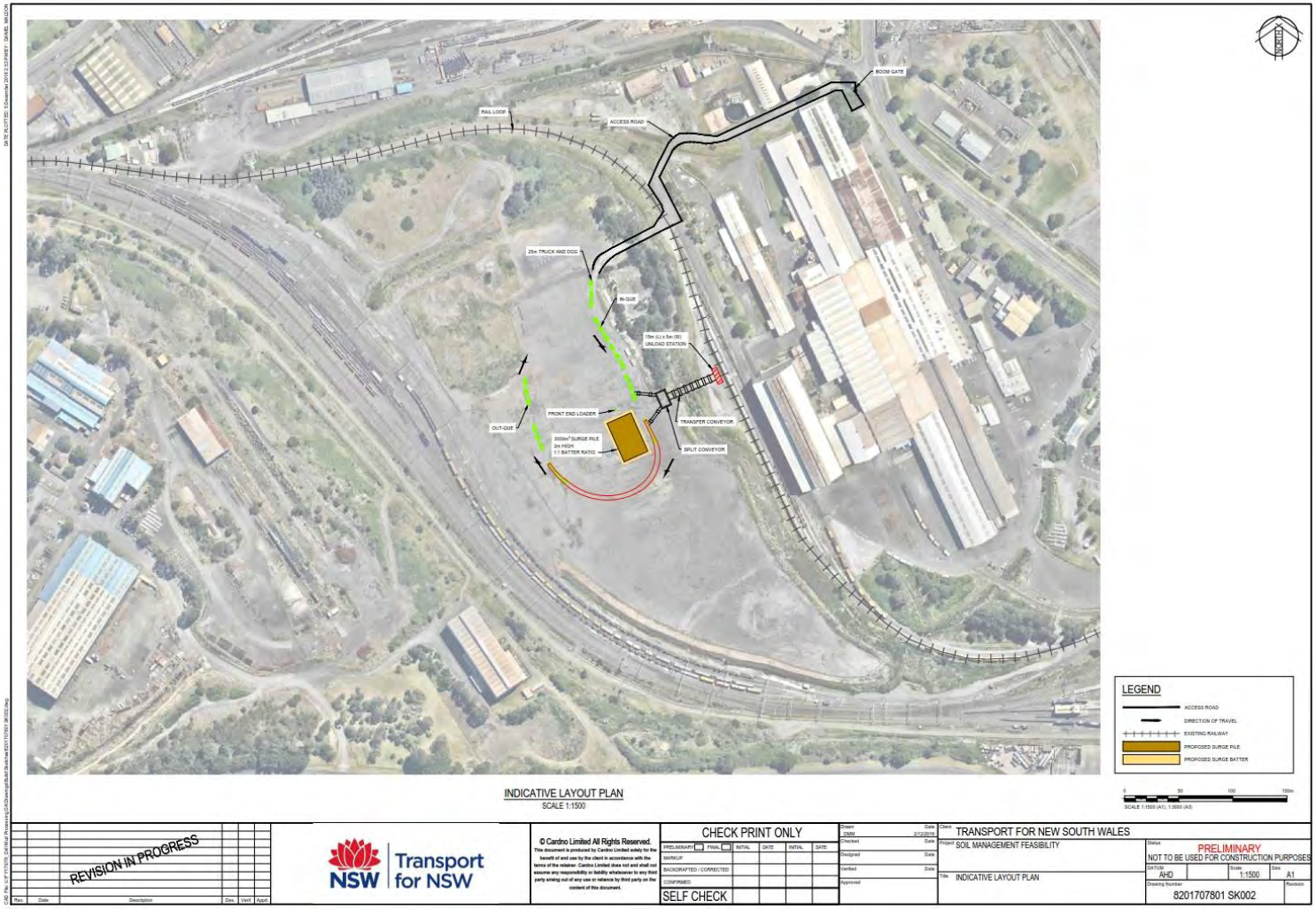


Figure 1.2 Concept Layout - CRM Site

2. Air Quality Issues and Effects

From an air quality perspective, it is important to consider the potential emissions that would occur during the operation of the Proposal. The key pollutants will be those associated with material transfer and freight activities will include particulate matter (TSP, PM_{10} and $PM_{2.5}$).

Particulate matter has the capacity to affect health and to cause nuisance effects, and is categorised by size and/or by chemical composition. The potential for harmful effects depends on both. The particulate size ranges are commonly described as:

- TSP (Total Suspended Particulate) – refers to all suspended particles in the air. The upper size range is typically 30 µm.
- PM_{10} – refers to all particles with equivalent aerodynamic diameters of less than 10 µm, that is, all particles that behave aerodynamically in the same way as spherical particles with diameters less than 10 µm and with unit density (1 g/m^3) PM_{10} are a sub-component of TSP.
- $PM_{2.5}$ – refers to all particles with equivalent aerodynamic diameters of less than 2.5 µm (a subset of PM_{10}). These are often referred to as the fine particles and are a sub-component of PM_{10}.
- $PM_{2.5-10}$ – defined as the difference between PM_{10} and $PM_{2.5}$ mass concentrations. These are often referred to as coarse particles.

Evidence suggests that health effects from exposure to airborne particulate matter are predominantly related to the respiratory and cardiovascular systems (WHO, 2011). The human respiratory system has in-built defensive systems that prevent larger particles from reaching the more sensitive parts of the respiratory system. Particles larger than 10 µm, while not able to affect health, can soil materials and generally degrade aesthetic elements of the environment. For this reason air quality goals make reference to measures of the total mass of all particles suspended in the air, referred to as TSP. In practice particles larger than 30 to 50µm settle out of the atmosphere too quickly to be regarded as air pollutants.

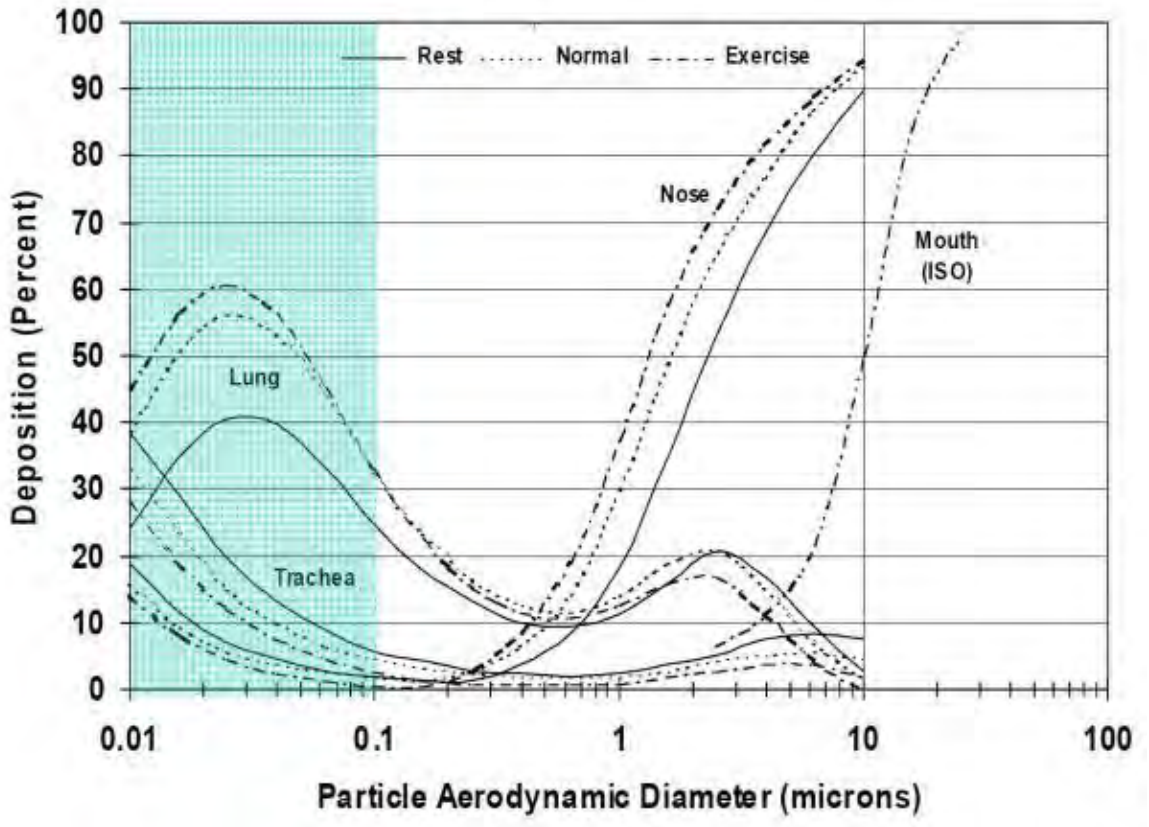
Both natural and anthropogenic processes contribute to the atmospheric load of particulate matter. Coarse particles ($PM_{2.5-10}$) are derived primarily from mechanical processes resulting in the suspension of dust, soil, or other crustal materials from roads, farming, mining and dust storms. Coarse particles also include sea salts, pollen, mould, spores, and other plant parts. Mining dust is likely to be composed of predominantly coarse particulate matter (and larger).

Fine particles, or $PM_{2.5}$, are derived primarily from combustion processes, such as vehicle emissions, wood burning, coal burning for power generation and natural processes such as bush fires. Fine particles also consist of transformation products, including sulphate and nitrate particles, and secondary organic aerosols from volatile organic compound emissions. $PM_{2.5}$ may penetrate beyond the larynx and into the thoracic respiratory tract and evidence suggests that particles in this size range are more harmful than the coarser component of PM_{10}.

The size of particles determine their behaviour in the respiratory system, including how far the particles are able to penetrate, where they deposit, and how effective the body's clearance mechanisms are in removing them. This is demonstrated in Figure 2.1, which shows the relative deposition by particle size within various regions of the respiratory tract. Additionally, particle size is an important parameter in determining the residence time and spatial distribution of particles in ambient air and is a key consideration in assessing exposure.

The health-based assessment criteria used by the New South Wales Environment Protection Authority (NSW EPA) have, to a large extent, been developed by reference to epidemiological studies undertaken

in urban areas with large populations where the primary pollutants are the products of combustion (National Environment Protection Council [NEPC], 1998a; NEPC, 1998b). This means that, in contrast to dust of crustal origin, the particulate matter from urban areas would be composed of smaller particles and would generally contain substances that are associated with combustion.



Source: Chow, 1995

Figure 2.1: Particle deposition within the respiratory tract

3. Air Quality Criteria

The assessment is based on a conventional approach generally following the procedures outlined in the NSW Environment Protection Authority's (EPA) document titled "Approved Methods and Guidance for the Modelling and Assessment of Air Pollutants in NSW" (NSW DEC, 2005), hereafter referred to as the 'Approved Methods'.

The Approved Methods specify air quality assessment criteria relevant for assessing impacts from air pollution. The air quality criteria relate to the total dust burden in the air and not just the dust from proposed activities. In other words, consideration of background dust levels needs to be made when using these criteria to assess potential impacts.

Table 3.1 summarises the air quality criteria for concentrations of particulate matter that are relevant to this study. These criteria are consistent with the now superseded National Environment Protection Measure for Ambient Air Quality (referred to as the Ambient Air-NEPM) (NEPC, 1998a). However, the NSW EPA's criteria include averaging periods which are not included in the Ambient Air-NEPM, and also reference other measures of air quality, namely dust deposition and TSP. Within this assessment, criteria from both the NEPM and Approved Methods have been applied.

In January 2016, the NEPC released an amended Ambient Air-NEPM (NEPC, 2016) to take into account the latest scientific evidence about the health impacts of particles. The amendment changed the 'advisory reporting standards' status for annual average and 24-hour average $PM_{2.5}$ to 'standards', but in absence of any other relevant assessment criteria, the 2016 NEPM for $PM_{2.5}$ standards have been used in this report for comparison against dispersion modelling results.

Table 3.1: NSW air quality criteria/standards for particulate matter concentrations

Pollutant	Standard	Averaging Period	Source
PM_{10}	50 µg/m^3 30 µg/m^3	24-Hour Annual	NSW DEC (2005)
$PM_{2.5}$	25 µg/m^3 8 µg/m^3	24-Hour Annual	NEPC (2016)
TSP	90 µg/m^3	Annual	NSW DEC (2005)

Note: µg/m^3 = micrograms per cubic metre

In addition to health impacts, airborne dust also has the potential to cause nuisance effects by depositing on surfaces, including native vegetation and crops. Larger particles do not tend to remain suspended in the atmosphere for long periods of time and will fall out relatively close to source. Dust fallout can soil materials and generally degrade aesthetic elements of the environment, and are assessed for nuisance or amenity impacts.

Table 3.2 shows the maximum acceptable increase in dust deposition over the existing dust levels from an amenity perspective. These criteria for dust fallout levels are set to protect against nuisance impacts (NSW DEC, 2005).

Table 3.2: NSW criteria for dust deposition (insoluble solids)

Pollutant	Averaging period	Maximum increase	Maximum total
Deposited dust	Annual	2 g/m^2/month	4 g/m^2/month

Note: g/m^2/month = grams per square metre per month

4. Emissions to Air – Construction Phase

Construction phase of the Project has been estimated to take place over three weeks at each site, and would include the following activities:

Chullora Site

- Protection of heritage rail assets via the application of fill.
- Signage and Access Improvements – minor works.
- Extension of rail line, 2 x 120 m sections.
- Transfer of material handling equipment to site.

Chullora Site construction equipment would include a 12 t smooth drum roller, a 30 t excavator and a mobile crane.

CRM Site

- Access Gate Improvements – boom gate installation
- Signage and Road Improvements – minor works
- Excavation of L15 x W3 x 1.5H pit for Unloading Equipment
- Transfer and installation of unloading equipment to site.

CRM Site construction equipment would include a 12 t smooth drum roller, a 30 t excavator and a mobile crane.

The potential air quality impacts associated with construction works are considered to be minor, and of a scale appropriate for management via routine construction environmental management procedures. Accordingly, associated recommendations are provided in Section 8.

5. Emissions to Air – Operational Phase

As outlined in Section 2, the project involves the transfer of approximately 9,000 tonnes of soil per day by rail to the Illawarra. On the basis of this review of the Project, emissions from the following activities have been identified as relevant to the assessment of air emissions:

- Locomotive operations.
- Material transfer operations (loading and unloading).
- Surge Piles.
- Hauling on unsealed roads.

The following sections provide a detailed estimate of particulate matter emissions from these operations at the CRM Site. A relative estimate of emissions from the Chullora operations is also provided.

5.1 Locomotive Operations

Whilst locomotive operations currently occur on the CRM and Chullora Sites, an estimate of train unloading emissions has been included for the purpose of directly estimating emissions associated with the Project.

Spoil will be transported from Chullora to the CRM Site via rail in up to three trains per day, each comprising the following:

- Two 81 or 82 Class Locomotives.
- 45 wagons containing approximately 3,000 t of spoil in total.

At the CRM Site, each train will be unloaded in a period of approximately two hours using a bottom dump arrangement, whereby material is transferred into a hopper mounted within a dump station beneath the rail line. During this time, locomotive engines will be operational as required to move the train over the dump station one wagon at a time, whilst allowing material to transfer into the station. Locomotive operation during this time is expected to include a combination of idling and Notch 1 power operation.

ABMARC (2016) *Diesel Locomotive Emissions Upgrade Kit Demonstration Project Fuel Efficiency, Emissions and Noise Testing* provides current detail of emission monitoring conducted on NSW locomotives. This testing covers the 81 Class locomotive (as proposed for Project) as well as the Class 90 locomotive, which features a larger version of the EMD-710 engine used within the Class 82 locomotive. Accordingly ABMARC (2016) is considered a useful reference for the estimation of emissions from locomotives servicing the Project.

Locomotive emission estimates have been prepared assuming that:

- Both locomotives will operate continuously at Notch 1 output level.
- Particulate matter emissions and fuel consumption are representative of those from the Class 81 locomotive (ABMARC, 2016) (approximately 30% higher than measured for the Class 90 locomotive).

All locomotive particulate matter emissions have been assumed to occur as $PM_{2.5}$. Accordingly, these emissions are also contained within the PM_{10} and TSP particle fractions.

Table 5.1 provides a summary of this emission estimate.

Table 5.1 Emission estimate for locomotive operations

Particulate Class	Diesel Consumption* (L/hr)	Emission Factor** (g/L)	Emission Rate (g/hr)
TSP	110	0.72	79.2
PM_{10}			
$PM_{2.5}$			

Notes: *Diesel consumption based on 2 locomotives operating at Notch 1 output level. **Derived from ABMARC (2016).

5.2 Material Transfer Operations

Once dumped from rail wagons, spoil material would be conveyed to either surge piles or waiting trucks via an electrically-driven conveyor system. Where placed into surge piles, material would be loaded into trucks using a wheeled loader.

Site specific particulate matter emissions have been estimated using the moisture and wind speed dependent US EPA AP-42 emission factors for batch loading operations, as shown in Table 5.2. A moisture content of 10% has been applied to reflect that nature of spoil that has been primarily sourced from below the water table and further wetted during tunnel boring processes. Average wind speed has been based on BlueScope wind monitoring data at the CRM Site for the year 2015.

Table 5.2 Site specific material handling emission factors

Particulate Class	Wind Speed (m/s)	Moisture Content (%)	k	Emission Factor (g/t throughput)
TSP	3.0	10	0.74	0.19
PM_{10}			0.35	0.0881
$PM_{2.5}$			0.053	0.01

Train unloading would occur at a rate of approximately 1,500 t/hr, for two hours, and on up to three separate occasions each day. Wheeled loader operations would occur on a more consistent basis, assumed to be constant for the purposes of this assessment. In addition, for simplicity, it has been assumed that all spoil material passes from the conveyor system to the surge pile, after which it loaded into trucks using a wheeled loader. This represents a conservative estimate for cases where material is loaded directly into trucks from the conveyor system.

In addition, the following control efficiencies have been applied, as based on those provided within NPI (2012) *National Pollutant Inventory Emission Estimation Technique Manual for Mining*:

- Enclosure of conveyor drop/transfer points (excluding the final loading transfer point): 70%
- Use of a variable height stacker on the loading arm (as consistent with the minimisation of drop height): 25%.

Table 5.3 provides a summary of emission estimates for material transfer operations.

Table 5.3 Emission estimate for material handling operations

Emission Source	Throughput (t/hr)	Control Efficiency	Emission Rate (g/hr) TSP	PM_{10}	$PM_{2.5}$
Spoil Import by Rail (3 x 2 hr events per day)					
Dump hopper	1,500	70%	84	40	6
Transfer Point #1	1,500	70%	84	40	6
Transfer Point #2	1,500	70%	84	40	6
Loading Arm	1,500	25%	209	99	15
Spoil Export by Haul Truck (24 hour operations)					
Wheeled FEL	375	0%	70	33	5

5.3 Surge Piles

Spoil material will be temporarily placed within a surge pile, which will contain up to 3,000 t (one train load) of spoil. The surge pile will be approximately 40 x 25 m in size, occupying an area of 0.1 hectares (ha). Relative to the remainder of the site, which is surfaced in a compacted gravel and vegetation, the surge pile has potential to generate particulate matter during high wind events. These emissions have been estimated using the US EPA AP-42 emission factors for wind erosion as shown in Table 5.4.

Table 5.4 Emission estimate for wind erosion from surge piles

Particulate Class	Surge Pile Area (ha)	Emission Factor (g/ha/hr)	Emission Rate (g/hr)
TSP	0.1	100	10
PM_{10}		50	5
$PM_{2.5}$		7.5	0.75

5.4 Hauling on Unsealed Roads

Truck and dog type haul trucks will access the CRM Site from Old Port Rd. Approximately 700 m of the haul route is unsealed. Emissions from truck movements on unsealed roads have been estimated using the US EPA AP-42 emission factors, as based on a nominal road surface silt content for gravel of 10%, and an average (of empty and full) truck weight of 32.5 t. These emission factors are shown in Table 5.5.

Table 5.5 Unsealed road emission factors

Particulate Class	Average Truck Weight (t)	Silt Content (%)	k	Emission Factor (g/VKT)
TSP	32.5	2	4.9	841
PM_{10}			1.5	257
$PM_{2.5}$			0.15	26

During peak operations, 255 haul trucks will carry spoil material from the site each day. Table 5.6 presents the emission estimates for these truck movements, incorporating an assumption that surface

moisture content will be maintained to a level that provides a 90% control efficiency against uncontrolled emissions.

Table 5.6 Emission estimate for hauling on unsealed roads

Particulate Class	Throughput (trucks/hr)	Haul Road Length (km)	Control Efficiency	Emission Rate (g/hr)
TSP	10.625*	0.69	90%	616
PM_{10}				189
$PM_{2.5}$				19

Note: *Hourly rate reflects a total of 255 truck movements per day.

5.5 Summary of CRM Site Emission Estimates

A summary of emission estimates is presented in Table 5.7 and Figure 5.1. Emissions for locomotives and train unloading activities have been multiplied by 6 (i.e. 3 x 2-hr unloading events per day). For all other emissions (which have been assessed to occur on a continuous basis), hourly emission estimates have been multiplied by 24.

Table 5.7 Summary of CRM Site daily emission estimates.

Emission Source	Emission Rate (kg/day)		
	TSP	PM_{10}	$PM_{2.5}$
Material Transfer Operations	4.4	2.1	0.32
Locomotive Operations	0.48	0.48	0.48
Hauling on Unsealed Roads	14.8	4.5	0.45
Wind erosion from Surge Piles	0.24	0.12	0.02
TOTAL	**19.9**	**7.2**	**1.3**

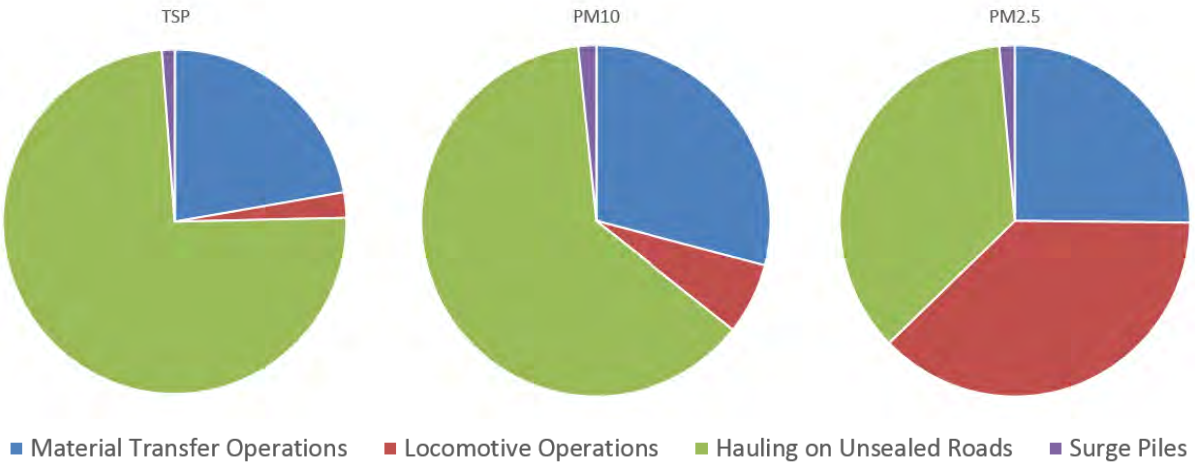


Figure 5.1 CRM Site: daily particulate matter emission contribution by class and source type

As shown in Figure 5.1, surge piling only forms a small contribution to total emissions, whilst hauling on unsealed roads makes a key contribution to both TSP and PM_{10} emissions, and locomotives comprise

the majority of $PM_{2.5}$ emissions. Material transfer operations make a minor contributions across all particulate classes.

A quantitative dispersion modelling assessment of these emissions is provided in Section 6 of this report.

5.6 Chullora Site Emission Estimates

It is noted that operations at both the CRM and Chullora sites involve the handling of the same spoil using similar material handling and freight methods. Assuming the same number of material transfer points in the conveyor system, the key difference in emissions would be the absence of unsealed roads at the Chullora Site. In addition, it is estimated that train loading would take place over a three hour period as compared to a two hour duration at the CRM Site. On this basis, relative emission estimates specific to the Chullora Site are provided in Table 5.8. A visual representation of the relative source contribution is provide in Figure 5.2. A qualitative assessment of these emissions is provided in Section 7 of this report.

Table 5.8 Emission estimates for the Chullora Site.

Emission Source	Emission Rate (kg/day)		
	TSP	PM_{10}	$PM_{2.5}$
Material transfer operations	4.4	2.1	0.32
Locomotive operations	0.71	0.71	0.71
Wind Erosion from Surge Piles	0.24	0.12	0.02
TOTAL	**5.4**	**2.9**	**1.1**

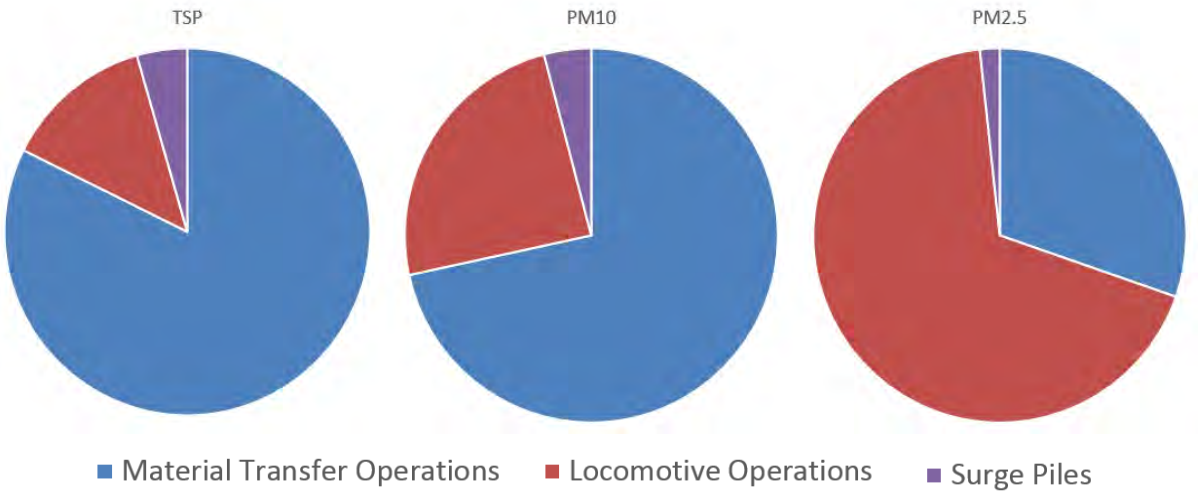


Figure 5.2 Chullora Site: daily particulate matter emission contribution by class and source type

It is noted that the absence of haul road emissions from these estimates is reflective of roads that are maintained in a generally clean condition.

6. Quantitative Assessment of CRM Operations

A dispersion modelling assessment of the CRM Site has been undertaken following the Approved Methods Level 2 assessment methodology. The Approved Methods include guidelines for the preparation of meteorological data to be used in dispersion models and the relevant air quality criteria for assessing the significance of predicted concentration and deposition rates from the Project.

6.1 Dispersion Model Selection

AERMOD dispersion model has been adopted as the most suitable model due to the source types, location of nearest receivers and nature of local topography. AERMOD is the US EPA's recommended steady-state plume dispersion model for regulatory purposes and it is an accepted model of the NSW EPA. AERMOD replaced the Industrial Source Complex (ISC) model for regulatory purposes in the US in December 2006.

A significant feature of AERMOD is the Pasquill-Gifford stability based dispersion is replaced with a turbulence-based approach that uses the Monin-Obukhov length scale to account for the effects of atmospheric turbulence. The AERMOD system includes AERMET, used for the preparation of meteorological input files and AERMAP, used for the preparation of terrain data.

Terrain data for the wider area was sourced from NASA's Shuttle Radar Topography Mission (SRTM) Data (1 arc second [~30m] resolution). The complete terrain dataset was then processed within AERMAP to create the necessary input files.

Appropriate values for three surface characteristics are required for AERMET as follows:

- Surface roughness, which is the height at which the mean horizontal wind speed approaches zero, based on a logarithmic profile.
- Bowen ratio, which is an indicator of surface moisture.
- Albedo, which is an indicator of reflectivity of the surface.

Values of surface roughness, Bowen ratio and albedo were designated based on a review of aerial photography.

6.2 Existing Environment

This section describes the general climate in the study area to give a more complete picture of the local conditions.

Local Climate

Table 6.1 presents the temperature, humidity and rainfall data for the closest Bureau of Meteorology (BoM) site which is located at Bellambi approximately 12 km north-east of the site. Humidity data consist of monthly averages of 9 am and 3 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean monthly rainfall and the average number of rain days per month.

The annual average maximum and minimum temperatures recorded at the Bellambi station are 21.3°C and 14.7 °C respectively. On average, January and February are the hottest months, with an average maximum temperature of 24.8°C. July is the coldest month, with average minimum temperature of 10.1°C. The annual average relative humidity reading collected at 9am is 66% and at 3pm the annual average is 65%. The month with the highest relative humidity on average is February

with 9am average of 76% and the month with the lowest relative humidity is August with a 3pm average of 54%.

Rainfall data collected at the Bellambi station shows that February is the wettest month, with an average rainfall of 137.3 mm over an average of 13.2 rain days. The average annual rainfall is 1113.9 mm with an average of 131 rain days per year.

Table 6.1 Summary of Climate Statistics for BoM Bellambi Weather Station (068228)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
9am Mean Dry-bulb and Wet-bulb Temperatures (ºC) and Relative Humidity (%)													
Dry-bulb	22	21.9	20.7	19.4	16.6	14.3	13	14.4	17	18	19	21	18.1
Humidity	75	76	74	66	63	63	60	56	59	62	72	71	66
3pm Mean Dry-bulb and Wet-bulb Temperatures (ºC) and Relative Humidity (%)													
Dry-bulb	23	23.3	22.6	20.7	18.5	16.5	16	16.7	18	19	20	22	19.7
Humidity	72	74	70	67	61	59	56	54	61	64	70	69	65
Daily Maximum Temperature (ºC)													
Mean	25	24.8	24	22.2	19.8	17.6	17	18	20	22	22	24	21.3
Daily Minimum Temperature (º C)													
Mean	19	19.2	18.1	15.6	13.1	11.2	10	10.6	13	14	16	18	14.7
Rainfall (mm)													
Mean	84	137	110	102	84.1	130	80	97.3	57	72	98	76	1113.9
Rain days (Number)													
Mean	12	13.2	13.4	10.8	9.3	10.4	9.1	8.3	9.2	11	13	12	131.2

Source: BOM (2016) Climate averages for Station: 068228; Commenced: 1988 – Last Record 2016; Latitude: 33.47°S; Longitude: 150.93 °E

Meteorology

Air quality impacts are influenced by meteorological conditions, primarily in the form of wind flow regimes, and by local conditions that are generally driven by topographical features and interactions with coastal influences. Wind speed, wind direction, temperature and relative humidity all affect the potential dispersion and transport of pollutants and are basic input requirements for dispersion modelling.

Site-specific dispersion meteorology has been prepared for the year 2015 using monitoring records from the BlueScope Flagstaff Road AQMS. These data have been combined with BoM cloud cover records and processed in the Lakes Environmental AERMET processor to provide surface and profile datasets for use in the AERMOD dispersion model.

Figure 6.1 provides annual and seasonal wind roses for the BlueScope Flagstaff Road AQMS, as incorporated into the AERMOD meteorological dataset.

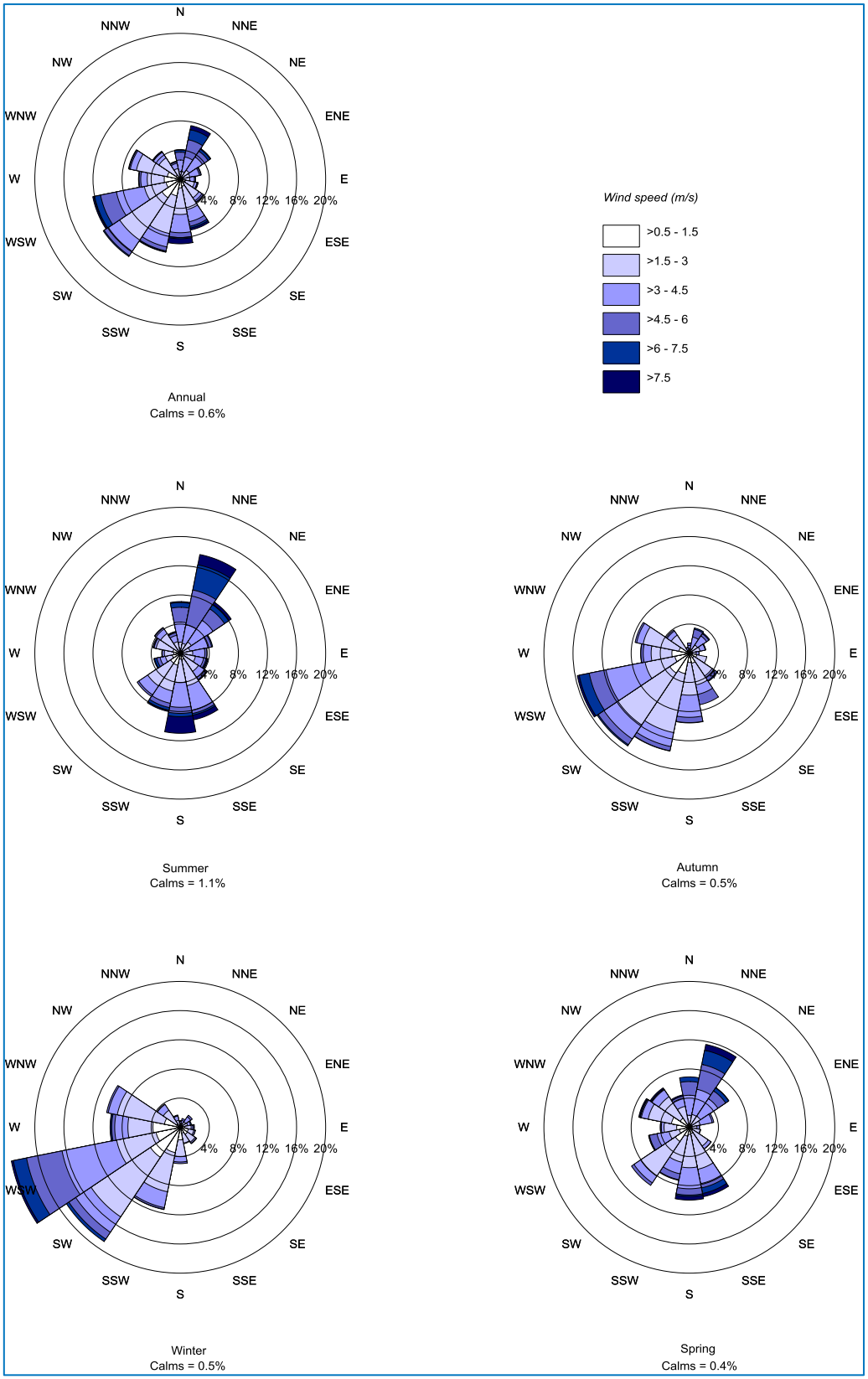


Figure 6.1 Annual and seasonal wind roses for the BlueScope Flagstaff Road AQMS.

Background Air Quality

As outlined in Section 5, the impact assessment criteria apply to the cumulative sum of emissions from the Project, and background pollutant levels. Accordingly, background data has been sourced in the vicinity of the CRM site, and adopted as being representative of air pollutant levels within the modelling domain.

Background data has been sourced from the following monitoring locations:

- PM_{10}: BlueScope operated Flagstaff St Air Quality Monitoring Station (AQMS) – Approximately 1.5 km west of the CRM Site;
- $PM_{2.5}$:
    - Office of Environment and Heritage (OEH) operated Kembla Grange AQMS – Located approximately 7 km west of the CRM Site;
    - Office of Environment and Heritage (OEH) operated Wollongong AQMS – Located approximately 7 km north of the CRM Site;
- TSP and Deposited Dust: BlueScope operated Flagstaff St Air Quality Monitoring Station (AQMS) – Located approximately 1.0 km west of the CRM Site;

Figure 6.2 provides an overview of the AQMS locations relative to the CRM site.

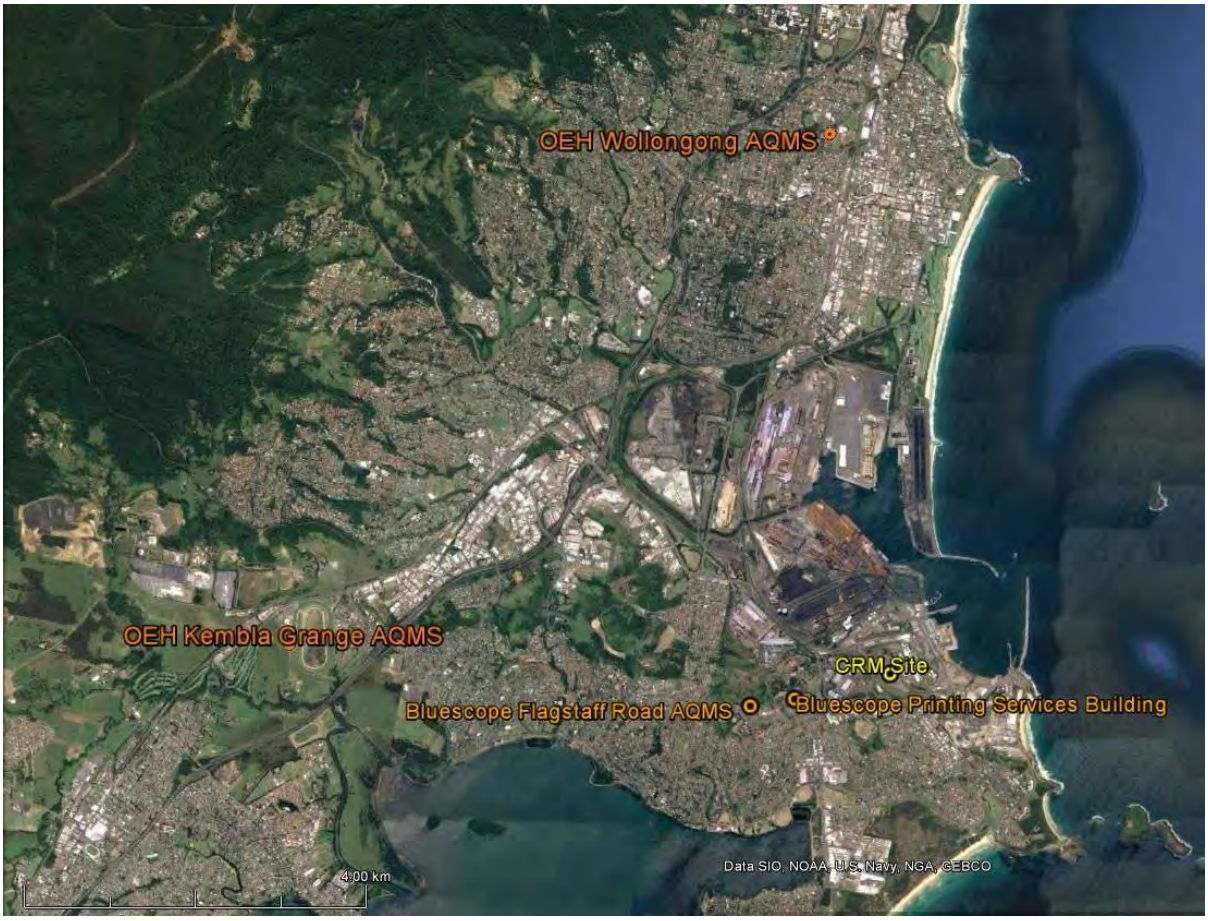


Figure 6.2 Overview of the AQMS locations relative to the CRM site.

Note: Image sourced from Google Earth

In order to understand differences in particulate matter levels between the Flagstaff road and Kembla Grange sites, a basic comparison of PM_{10} monitoring data was undertaken, as presented in Figure 6.3.

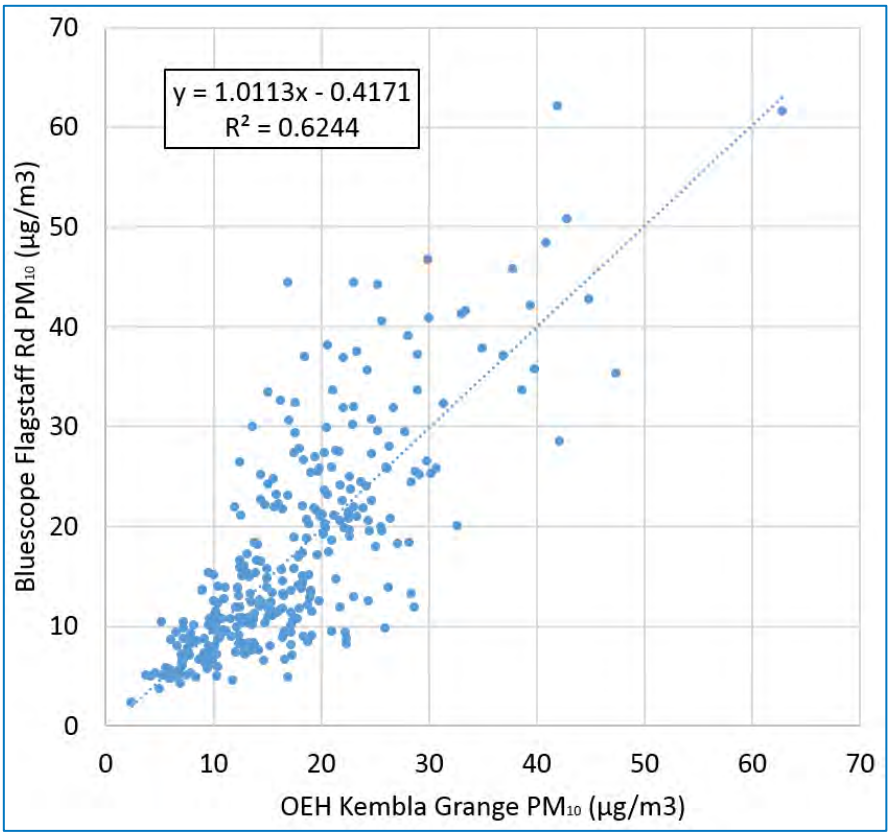


Figure 6.3 Comparison of Flagstaff road and Kembla Grange monitoring data.

As evident in the figure there is a linear correlation between particulate matter levels at the two sites. 2015 levels at the Kembla Grange site were found to be on average 1.3% higher than at Flagstaff road, as based on an analysis of days where results were available for both stations. Accordingly, Kembla Grange data has been used to supplement the Flagstaff road data for the 10% of days where Flagstaff road data was not available. In addition, $PM_{2.5}$ data has also been sourced from Kembla Grange, and where not available, substituted with Wollongong data.

Table 6.2 presents a summary of adopted background air quality levels for the assessment.

Table 6.2 Summary of adopted background air quality levels.

Pollutant	Annual Average	Units	Source / Data Availability
$PM_{2.5}$	6.7	µg/m³	OEH Kembla Grange (72.9%), Wollongong (25.7%)
PM_{10}	17.4	µg/m³	BlueScope Flagstaff Road (90%) OEH Kembla Grange (10%)
TSP	32.7	µg/m³	BlueScope Printing Services Building (56 x 1 in 6 day measurements)
Deposited Dust	1.8	g/m²/month	Bluescope Printing Services Building (12 monthly measurements)

6.3 Sensitive Receptors

The CRM Site operations are located at a distance of approximately 300 m from industrial and residential receptors. The operations are proposed to occur in a hardstand area of compacted gravel adjacent to existing rail infrastructure that has been historically used for steel manufacturing and distribution. Nearest residential receptors are those of Port Kembla, situated in a medium density suburban setting.

Modelling has been undertaken across a 4 x 4 km modelling domain of gridded receptors at a resolution of 100m, with inclusion of a finer grid of 50 m used on an inner 2 x 2 km nest. In addition, discrete receptors have been allocated to include closest residential and industrial receptors (radially), as well as suburban areas, and public sensitive areas (e.g. schools, hospitals).

Table 6.3 provides a summary of discrete receptor locations included within the extent of the gridded receptor domain. These locations are shown in Figure 6.4.

Table 6.3 Summary of discrete receptor type and location

Receptor ID	Receptor Type	Location (MGA94)	
		Easting (mE)	Northing (mN)
R1	Residential	307149	6182793
R2	Residential	307140	6182743
R3	Residential	307065	6182742
R4	Residential	307031	6182775
R5	Residential	306998	6182785
R6	Residential	306965	6182765
R7	Residential	306941	6182645
R8	Residential	306888	6182630
R9	Residential	306831	6182611
R10	Residential	306776	6182595
R11	Residential	306716	6182577
R12	Residential	306658	6182554
R13	Residential	306725	6182233
R14	Residential	306560	6182177
R15	Residential	306433	6182337
R16	Residential	306322	6182564
R17	Residential	306040	6182622
R18	Residential	305918	6182660
R19	Residential	305710	6182581
R20	Residential	305619	6182830
R21	Residential	305459	6182701
R22	Residential	305253	6182673
R23	Residential	305068	6182694
R24	Residential	304866	6182709
R25	Residential	304677	6182677
R26	Residential	304708	6182889
R27	Residential	304734	6183087
R28	Residential	304760	6183286
R29	Residential	304786	6183484
R30	Residential	304812	6183682
R31	Residential	304837	6183881
R32	Residential	304838	6184102
R33	Industrial	306863	6182786
R34	Industrial	306674	6182781
R35	Industrial	306485	6182784
R36	Industrial	306250	6182733
R37	Industrial	306052	6182730
R38	Industrial	305795	6182728
R39	Suburban Area - Port Kembla North	307028	6182488
R40	Suburban Area - Port Kembla	307199	6182188
R41	Suburban Area - Warrawong	306167	6182333
R42	Port Kembla Hospital	306138	6182000
R43	Suburban Area - Warrawong West	305057	6182225
R44	Warrawong Shopping Centre	305700	6182290
R45	Warrawong High School	304908	6182568
R46	Warrawong Public School	305129	6182430
R47	Port Kembla Hospital	305432	6181965
R48	Suburban Area - Cringila South	304600	6183060
R49	Suburban Area - Cringila	304600	6183460
R50	Suburban Area - Cringila North	304600	6183860

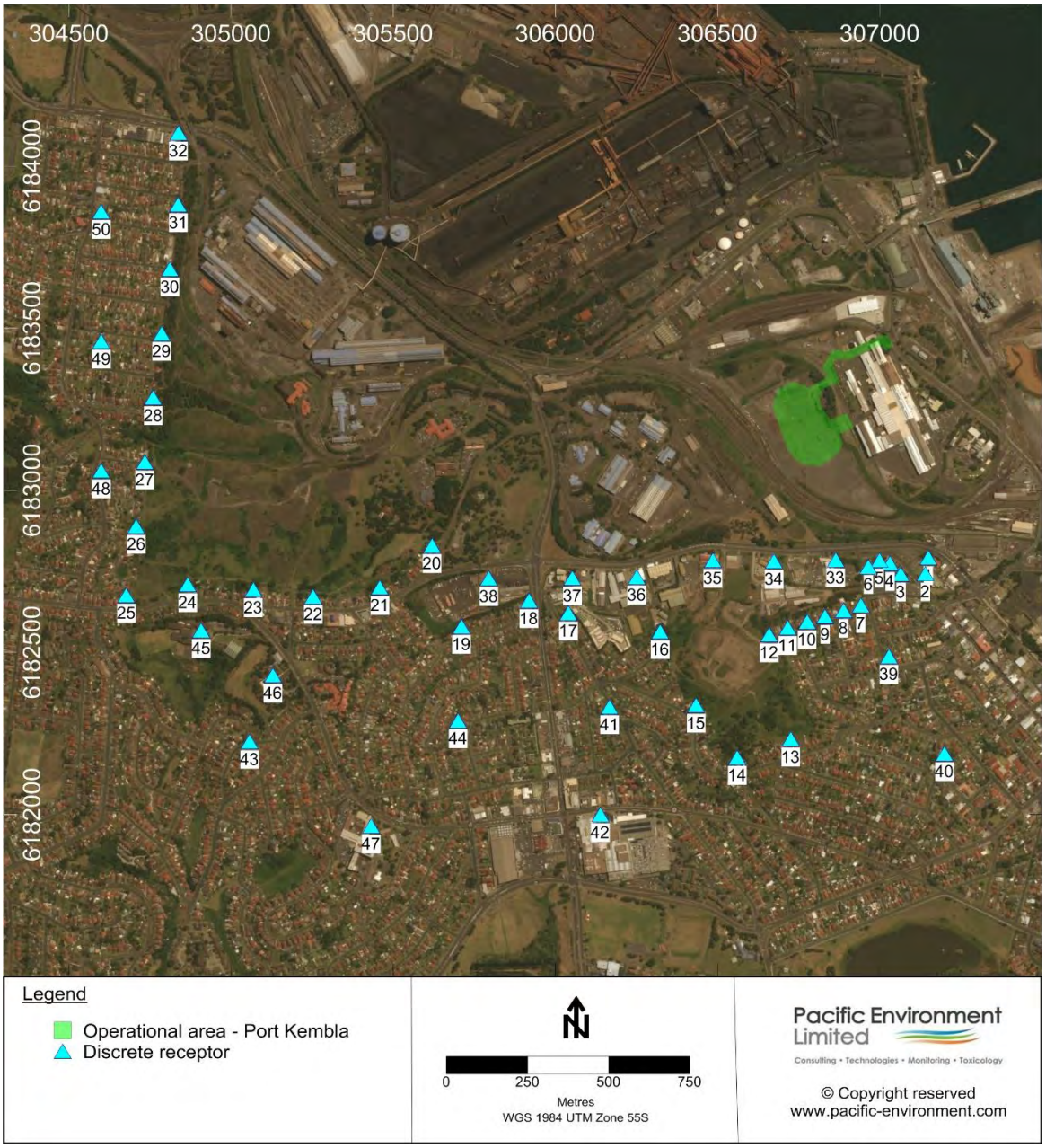


Figure 6.4 Aerial image showing discrete receptor locations for the CRM Site

6.4 Emission Source Configuration

Dispersion models rely on a physical representation of pollutant sources at or near to the point of their release. Given the diffuse nature of the emissions considered in this analysis, volume sources[1] have been adopted within the model. For this source type, the model requires information on location, height, and initial dimension of each emission source. Accordingly, a total of 76 volume sources have been configured in accordance with the site layout. A full summary of these sources is provided in Appendix A, including (as an example) modelled TSP emission rates.

[1] Volume sources are a type of emission source applied in dispersion models.

Emission Allocation

Modelled emission rates which have been calculated as gram per second from the hourly emission estimates provided in Section 7. Where an emission activity has been split into a number of volume sources (e.g. haul road and locomotive transit paths), emissions have been allocated evenly between the volume sources for that activity.

Temporal Variability

Given that train unloading will occur for a maximum of 3 x 2 hr periods per day, locomotive and associated material handling (conveyor) emission have been entered into the model to occur for 2 hours within an 8 hour cycle, with emission hours staggered by 1 hour for each successive day of the week. This approach ensures that both proposed activity rates and diurnal variability of dispersion conditions are adequately addressed within the model. Emissions for the wheeled loader, wind erosion and haul roads have been assumed to occur on a continuous basis for all hours of the modelling period.

6.5 Other Model Settings

Three separate model runs have been undertaken for PM_{10}, $PM_{2.5}$ and TSP/Deposition. Further detail of model configuration has been provided within the AERMOD PM_{10} model list file in Appendix B.

6.6 Modelling Results

The NSW EPA air quality assessment criteria used for identifying potential adverse air quality impacts and have been applied in this assessment. It is important to note that there are currently no regulatory impact assessment criteria for $PM_{2.5}$. In this absence, the predicted concentrations have been compared with the Ambient Air-NEPM standards for $PM_{2.5}$ and are applied at individual residential receptors.

Modelling results have been presented as both contour isopleths, and tabulated values at discrete receptors. Contour plots of particulate concentrations and deposition levels show the areas that are predicted to be affected by dust at different levels. These contour figures are presented to provide a visual representation of the predicted impacts. To produce the contours it is necessary to make interpolations, and as a result the contours will not always match exactly with predicted impacts at any specific location. The actual predicted particulate concentrations/levels at nearby residences are presented in tabular form.

Assessment of annual average cumulative impacts has been undertaken for discrete receptors within Table 6.4. In order to show the spatial variation of model predictions, contour plots have been prepared for the CRM site in isolation (i.e. on an incremental basis) for the following:

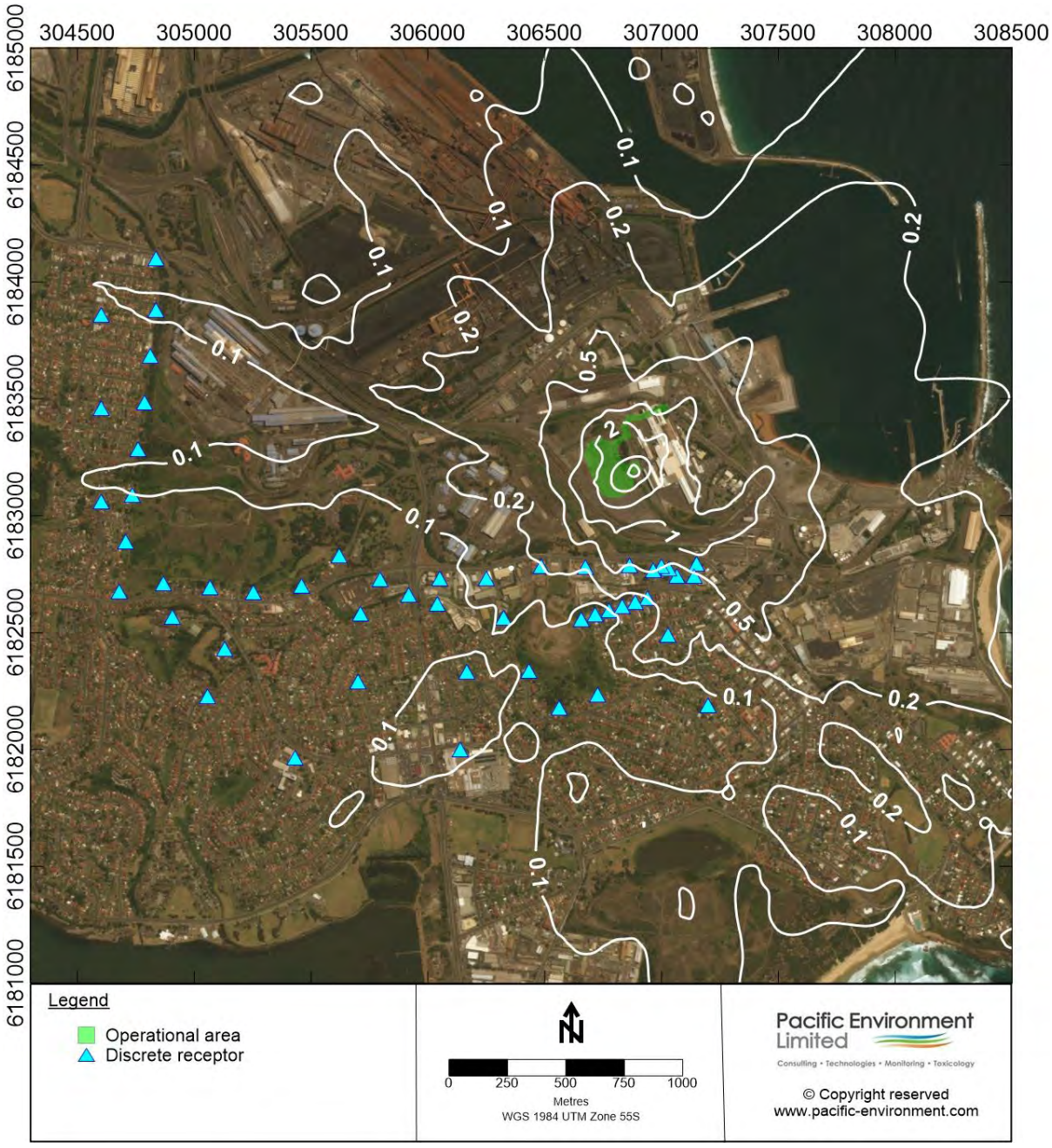
- Figure 6.5 Maximum Incremental 24-hour average $PM_{2.5}$ Predictions ($\mu g/m^3$)
- Figure 6.6 Maximum incremental 24-hour average PM_{10} Predictions ($\mu g/m^3$)
- Figure 6.7 Incremental annual average $PM_{2.5}$ predictions ($\mu g/m^3$)
- Figure 6.8 Incremental annual average PM_{10} predictions ($\mu g/m^3$)
- Figure 6.9 Incremental annual average TSP predictions ($\mu g/m^3$)
- Figure 6.10 Incremental annual average dust deposition predictions (g/m^2/month)

Lastly, assessment of 24-hour average cumulative impacts has been undertaken via a contemporaneous analysis as shown in Figure 6.11 and Figure 6.12.

Table 6.4 Summary of modelling results at discrete receptors

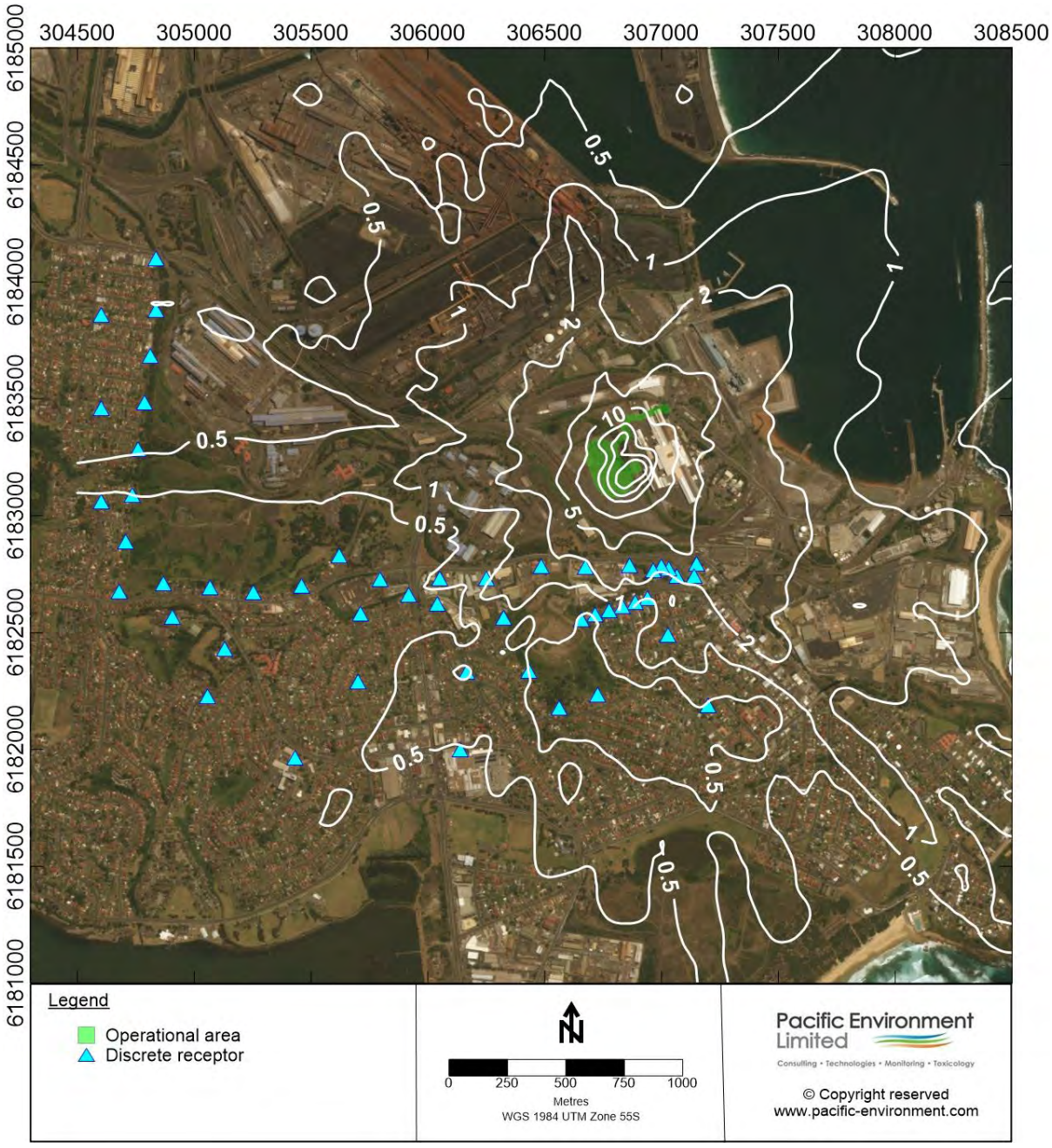
Receptor ID	24-hour average		Annual average			
	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	$PM_{2.5}$ ($\mu g/m^3$)	PM_{10} ($\mu g/m^3$)	TSP ($\mu g/m^3$)	Deposition (g/m^2/month)
R1	0.8	4.9	0.09	0.5	1.3	0.002
R2	0.4	2.9	0.05	0.3	0.80	0.001
R3	0.3	2.3	0.05	0.3	0.84	0.001
R4	0.4	2.5	0.06	0.3	0.94	0.001
R5	0.6	2.5	0.06	0.4	1.1	0.001
R6	0.5	2.2	0.06	0.4	1.0	0.001
R7	0.2	0.90	0.02	0.1	0.29	0.001
R8	0.1	1.1	0.01	0.09	0.24	0.000
R9	0.1	0.96	0.01	0.06	0.18	0.000
R10	0.09	0.65	0.01	0.05	0.13	0.000
R11	0.07	0.54	0.01	0.04	0.12	0.000
R12	0.06	0.40	0.01	0.04	0.11	0.000
R13	0.03	0.23	0.003	0.01	0.04	0.000
R14	0.04	0.17	0.003	0.02	0.04	0.000
R15	0.06	0.48	0.005	0.03	0.09	0.000
R16	0.13	0.96	0.007	0.05	0.15	0.001
R17	0.03	0.28	0.004	0.03	0.09	0.000
R18	0.06	0.47	0.004	0.03	0.09	0.000
R19	0.03	0.22	0.002	0.01	0.04	0.000
R20	0.02	0.12	0.001	0.01	0.02	0.000
R21	0.03	0.16	0.001	0.01	0.02	0.000
R22	0.02	0.11	0.001	0.00	0.01	0.000
R23	0.01	0.06	0.001	0.00	0.01	0.000
R24	0.02	0.06	0.001	0.00	0.01	0.000
R25	0.01	0.05	0.001	0.00	0.01	0.000
R26	0.02	0.10	0.001	0.01	0.02	0.000
R27	0.1	0.51	0.003	0.02	0.05	0.000
R28	0.07	0.44	0.002	0.01	0.03	0.000
R29	0.04	0.19	0.003	0.02	0.05	0.000
R30	0.05	0.18	0.003	0.02	0.05	0.000
R31	0.12	0.51	0.003	0.02	0.06	0.000
R32	0.05	0.21	0.004	0.02	0.07	0.000
R33	0.5	3.22	0.06	0.4	1.2	0.002
R34	0.2	1.7	0.03	0.2	0.54	0.002
R35	0.2	1.4	0.02	0.1	0.34	0.002
R36	0.2	0.85	0.01	0.1	0.31	0.001
R37	0.09	0.63	0.007	0.05	0.16	0.000
R38	0.05	0.28	0.003	0.02	0.07	0.000
R39	0.3	1.2	0.02	0.1	0.33	0.000
R40	0.06	0.44	0.005	0.03	0.09	0.000
R41	0.20	1.1	0.009	0.06	0.17	0.001
R42	0.12	0.49	0.009	0.06	0.17	0.000
R43	0.02	0.14	0.001	0.01	0.02	0.000
R44	0.05	0.33	0.003	0.02	0.07	0.000
R45	0.02	0.09	0.001	0.00	0.01	0.000
R46	0.02	0.07	0.001	0.00	0.01	0.000
R47	0.04	0.21	0.002	0.01	0.03	0.000
R48	0.08	0.40	0.002	0.01	0.03	0.000
R49	0.04	0.18	0.002	0.01	0.03	0.000
R50	0.07	0.24	0.002	0.01	0.04	0.000
Maximum	**0.81**	**4.9**	**0.1**	**0.5**	**1.35**	**0.002**
Background	Variable		6.7	17.4	32.7	1.8
Cumulative	-*		6.8	17.9	34.0	1.8
Criterion	25	50	8	30	90	2**/4***

Notes: *Contemporaneous analysis provided in the following section. **Incremental Criterion, ***Cumulative Criterion.



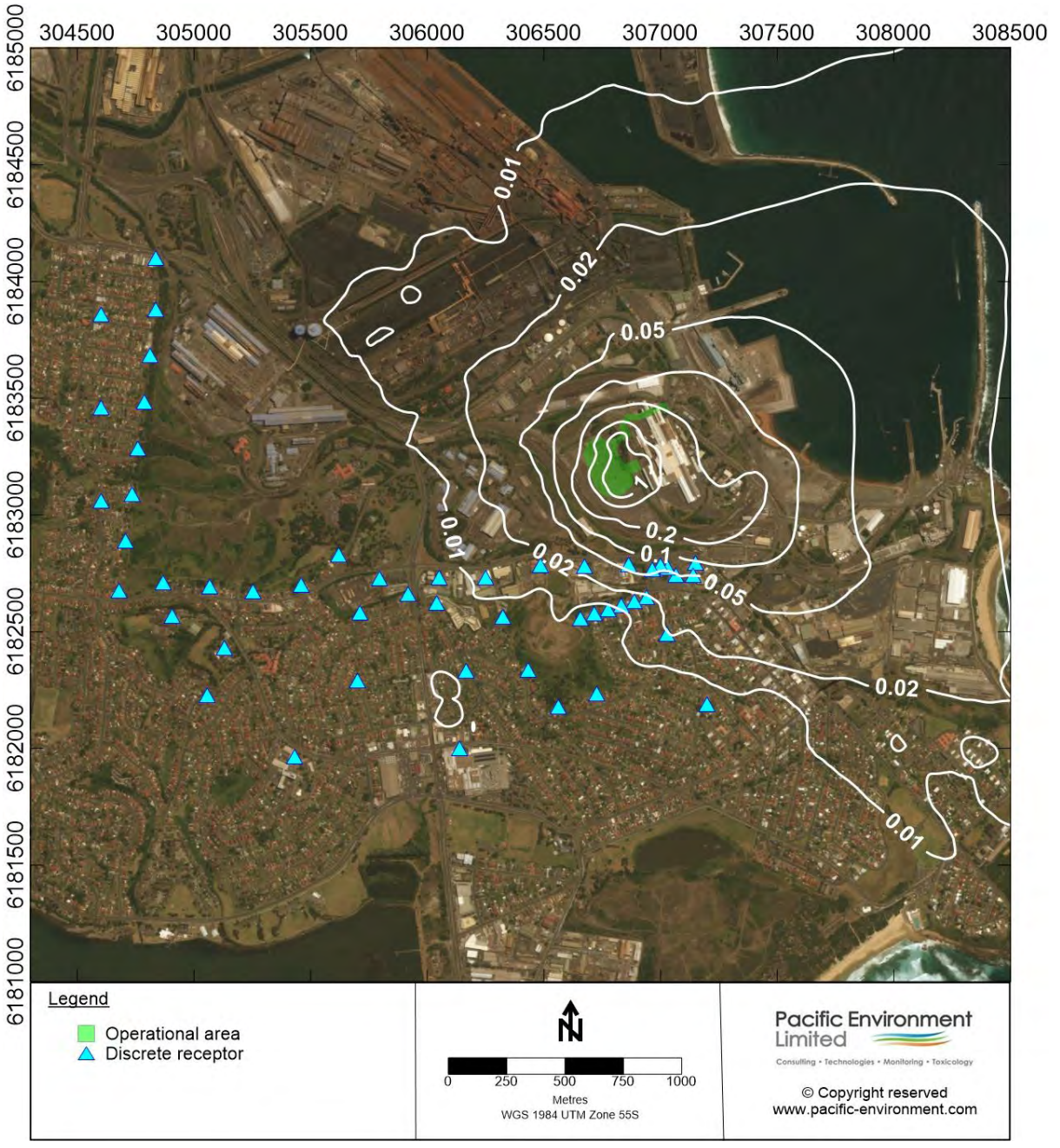
Pollutant: $PM_{2.5}$	**Location:** CRM Site	**Scenario:** Project Only	**Percentile:** 100^{th}	**Averaging Time:** 24 hour
Model: AERMOD	**Units:** $\mu g/m^3$	**Criterion:** -	**Met Data:** 2015	**Plot:** J. Grieve

Figure 6.5 Maximum Incremental 24-hour average $PM_{2.5}$ Predictions ($\mu g/m^3$)



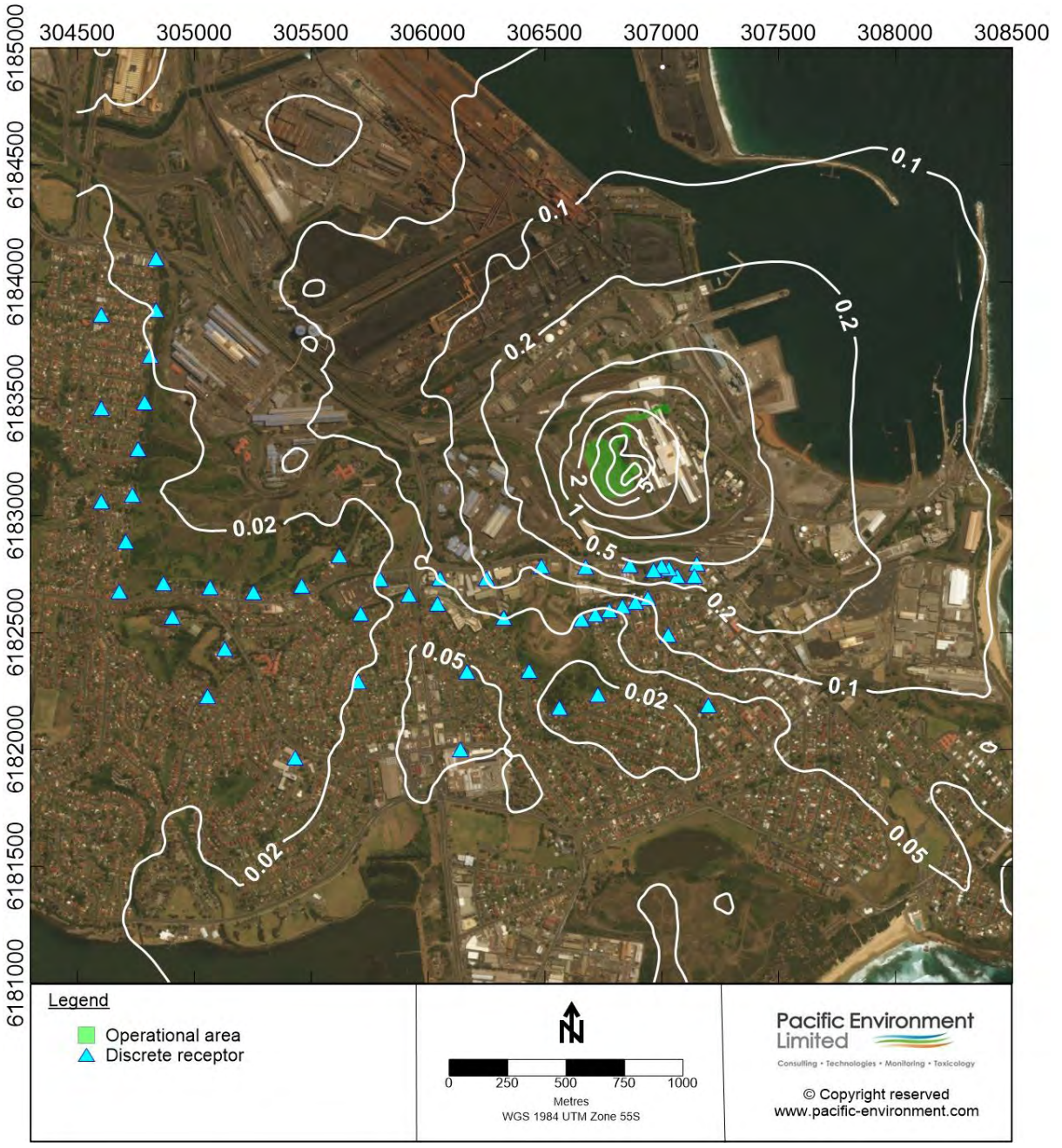
Pollutant: PM_{10}	**Location:** CRM Site	**Scenario:** Project Only	**Percentile:** 100th	**Averaging Time:** 24 hour
Model: AERMOD	**Units:** $\mu g/m^3$	**Criterion:** -	**Met Data:** 2015	**Plot:** JG

Figure 6.6 Maximum incremental 24-hour average PM_{10} Predictions ($\mu g/m^3$)



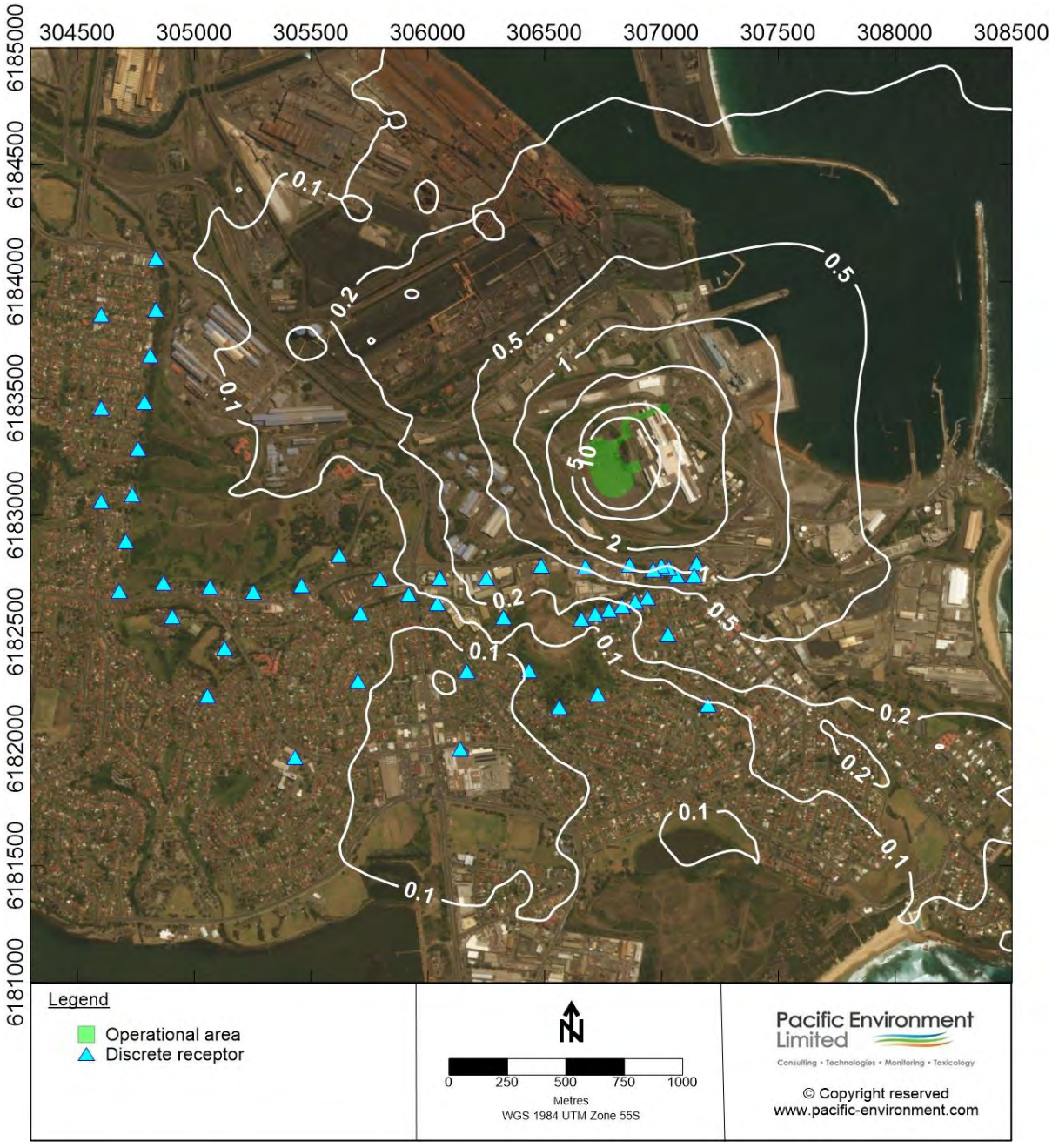
Pollutant:	Location:	Scenario:	Percentile:	Averaging Time:
$PM_{2.5}$	CRM Site	Project Only	-	Annual
Model:	**Units:**	**Criterion:**	**Met Data:**	**Plot:**
AERMOD	$\mu g/m^3$	-	2015	J. Grieve

Figure 6.7 Incremental annual average $PM_{2.5}$ predictions ($\mu g/m^3$)



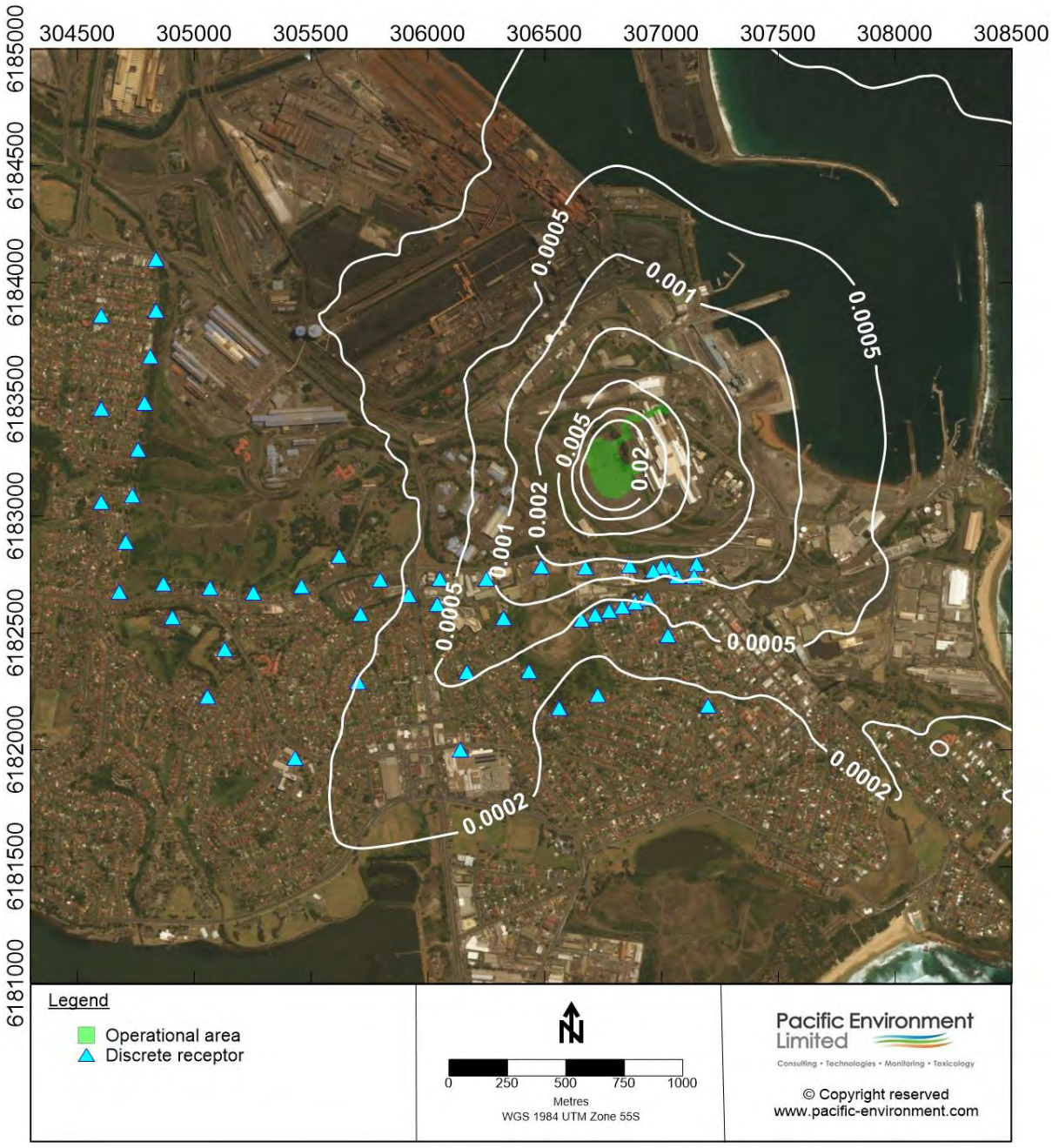
Pollutant:	Location:	Scenario:	Percentile:	Averaging Time:
PM_{10}	CRM Site	Project Only	-	Annual
Model:	**Units:**	**Criterion:**	**Met Data:**	**Plot:**
AERMOD	$\mu g/m^3$	-	2015	J. Grieve

Figure 6.8 Incremental annual average PM_{10} predictions ($\mu g/m^3$)



Pollutant: TSP	**Location:** CRM Site	**Scenario:** Project Only	**Percentile:** -	**Averaging Time:** Annual
Model: AERMOD	**Units:** µg/m^3	**Criterion:** -	**Met Data:** 2015	**Plot:** J. Grieve

Figure 6.9 Incremental annual average TSP predictions (µg/m^3)



Pollutant: Deposition	**Location:** CRM Site	**Scenario:** Project Only	**Percentile:** -	**Averaging Time:** Annual
Model: AERMOD	**Units:** g/m^2/month	**Criterion:** 2	**Met Data:** 2015	**Plot:** J. Grieve

Figure 6.10 Incremental annual average dust deposition predictions (g/m^2/month)

Contemporaneous Analysis of 24-hour average $PM_{2.5}$ and PM_{10} Predictions

Difficulties in predicting cumulative 24-hour average concentrations are compounded by the day-to-day variability in ambient dust levels, and the spatial and temporal variation in any other anthropogenic activity and natural events (for example agricultural activity, dust storms, bushfires etc.). The Proposal will also contribute to total particulate matter concentrations, however given the scale of predictions, these impacts are expected to be more localised.

The results presented for the Proposal alone demonstrate that the contribution to cumulative 24-hour average PM_{10} concentrations would be minor, with a maximum at the most affected residence (R1) predicted to be approaching 5 µg/m^3. This value is, by definition, the maximum value over the whole modelling year and is therefore predicted to be lower at all other times.

Figure 6.11 presents a time series of the measured and predicted 24-hour $PM_{2.5}$ concentrations at the nearest residence. It is clear from this that the Project contributions to the ambient air quality are minor and do not cause additional exceedances of the air quality criterion. It is noted that the single spike shown to be approaching the criteria was due to hazard reduction burns occurring at a regional level[2].

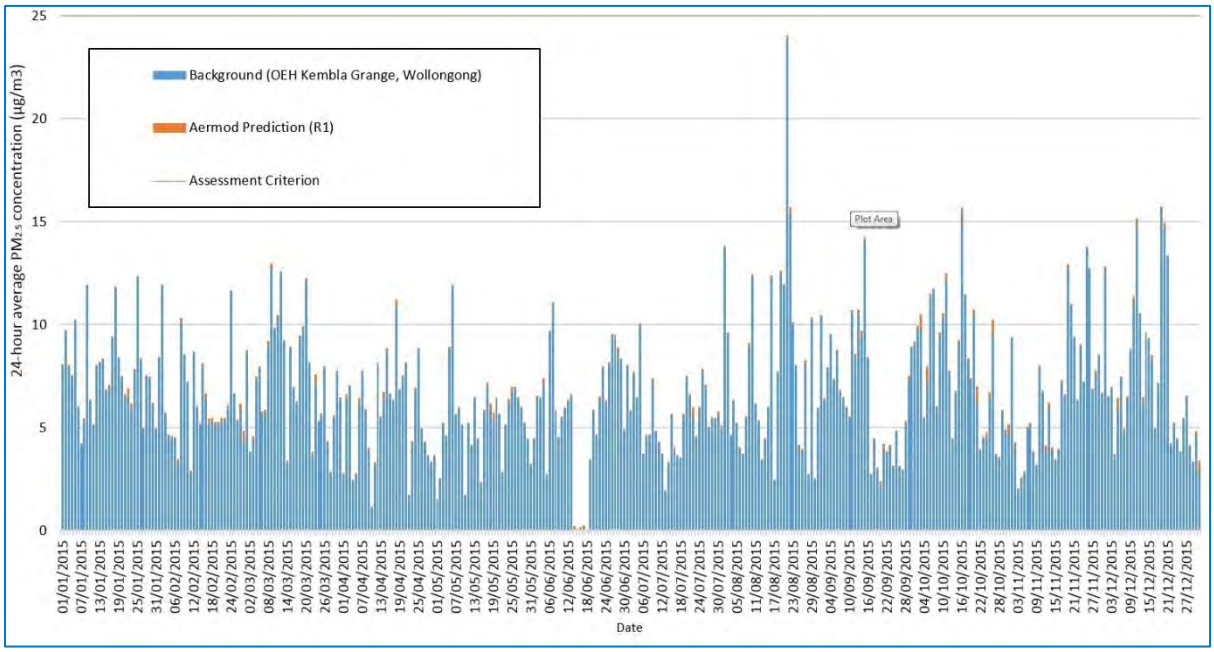


Figure 6.11 Contemporaneous analysis of cumulative 24-hour average $PM_{2.5}$ predictions

Figure 6.12 presents a time series of the measured and predicted 24-hour average PM_{10} concentrations at the nearest residence. Whilst cumulative predictions are approaching the criteria (maximum 49.9 µg/m^3), it is noted that the Project is not predicted to generate additional exceedances of air quality criteria[3], and that the contribution of the Project emissions to total levels at this peak location is predicted to be minor. A review of regional events that may have influenced the more elevated background concentrations has not been undertaken.

[2] NSW Health (2015) http://www.health.nsw.gov.au/news/Pages/20150821_00.aspx (accessed 20/12/2016).

[3] i.e. additional beyond those present within background monitoring data. That is, the Project complies with the assessment criteria of no additional exceedances.

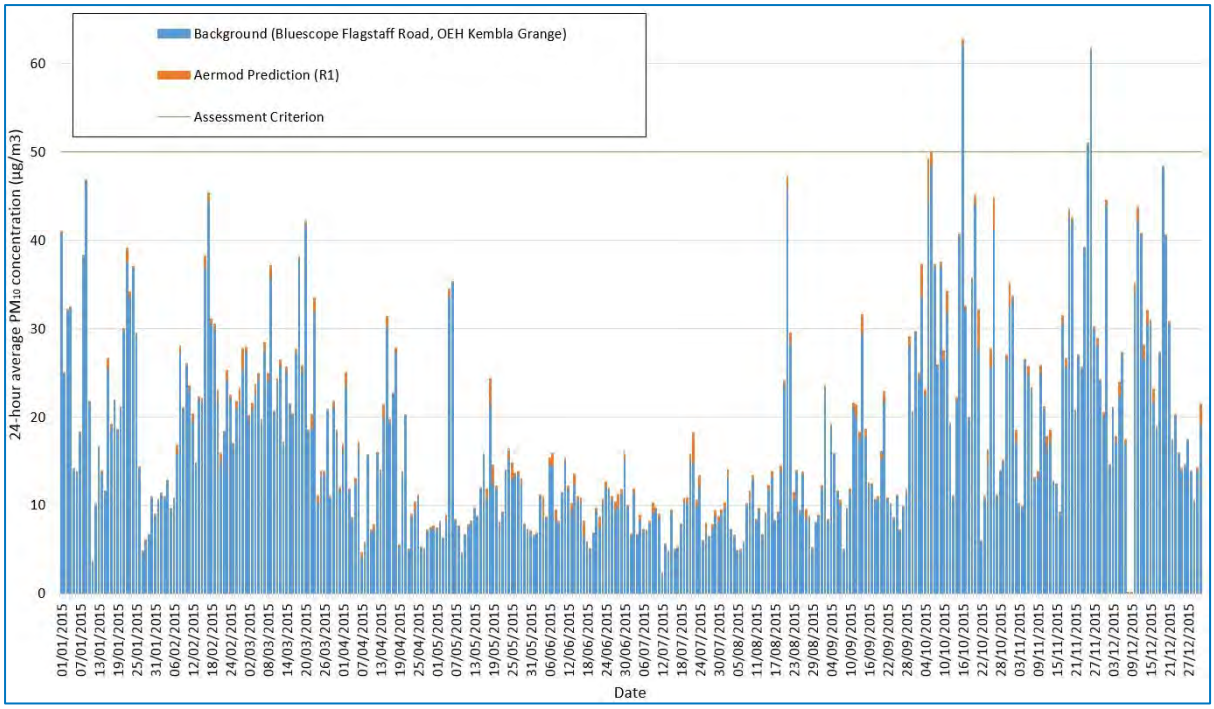


Figure 6.12 Contemporaneous analysis of cumulative 24-hour average PM_{10} predictions

Discussion of Results

Based on the analysis undertaken, the potential for the Project to result in adverse air quality impacts is considered to be low. With regard to the scale of model predictions it is noted that:

- Maximum 24-hour average PM_{10} predictions were of greatest significance comprising approximately 10% of impact assessment criteria. Maximum 24-hour average $PM_{2.5}$ predictions were of a lesser significance comprising approximately 3% of impact assessment criteria. Noting this, the predictions have been shown to be minor in the context of existing background levels, and were assessed to not generate additional exceedance of the 24-hour criteria.
- All annual average predictions ($PM_{2.5}$, PM_{10}, TSP and Dust Deposition) were minor constituting less than 5% of both regulatory criteria and existing background levels in all cases.

Table 6.5 presents a simple analysis of source contribution to peak PM_{10} predictions at Receptor R1.

Table 6.5 Analysis of source contribution for peak 24 hour average PM_{10} predictions

Source Group	Peak 24-hr average PM_{10} Prediction (µg/m^3)	Percentage of 'All Sources' Prediction
Material handling during train unloading	1.4	29%
Unsealed Haul Roads	2.7	55%
Surge kpile and wheeled loader operation	0.7	14%
Locomotive engines	0.4	8%
All Sources	**4.9**	**-**

Note: Source group totals are non-additive due to the potential for separate peak source group contributions to occur under separate meteorological conditions within the model.

As can be seen within the data, emissions from haul roads, and material handling form a key contribution to peak predictions, whilst surge pile operations and locomotives form a lesser contribution.

7. Qualitative Assessment of Chullora Operations

7.1 Existing Environment

Local Climate

Table 7.1 presents the temperature, humidity and rainfall data for the closest BoM site which is located at Canterbury Racecourse approximately 5 km south-east of the site. Humidity data consist of monthly averages of 9 am and 3 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean monthly rainfall and the average number of rain days per month.

The annual average maximum and minimum temperatures recorded at the Canterbury Racecourse station are 23.0°C and 12.3 °C respectively. On average, January is the hottest month, with an average maximum temperature of 27.6°C. July is the coldest month, with average minimum temperature of 5.8°C. The annual average relative humidity reading collected at 9am is 69% and at 3pm the annual average is 53%. The month with the highest relative humidity on average is February with 9am average of 74% and the month with the lowest relative humidity is August with a 3pm average of 42%.

Rainfall data collected at the Canterbury Racecourse station shows that April is the wettest month, with an average rainfall of 110.0 mm over an average of 11.7 rain days. The average annual rainfall is 558.6 mm with an average of 129 rain days per year.

Table 7.1 Summary of Climate Statistics for BoM Canterbury Weather Station (066194)

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
9am Mean Dry-bulb and Wet-bulb Temperatures (ºC) and Relative Humidity (%)													
Dry-bulb	22.7	22.3	20.4	18	14.7	11.9	11	12.8	16.5	18.7	19.8	21.6	17.5
Humidity	68	74	76	72	73	76	73	62	59	59	66	66	69
3pm Mean Dry-bulb and Wet-bulb Temperatures (ºC) and Relative Humidity (%)													
Dry-bulb	25.9	25.7	24.5	22	19.3	17.1	16	17.8	20.4	21.5	22.8	24.7	21.5
Humidity	57	60	58	57	54	54	50	42	46	50	54	54	53
Daily Maximum Temperature (ºC)													
Mean	27.6	27.2	26	23	20.6	18.1	18	19	21.9	23.5	24.8	26.3	23
Daily Minimum Temperature (º C)													
Mean	18.3	18.3	16.5	13	9.3	7.1	5.8	6.5	9.5	12.1	14.9	16.7	12.3
Rainfall (mm)													
Mean	85.2	99.1	74.6	111	81.1	108	60	66.8	46.8	59	78.7	64.7	958.6
Rain days (Number)													
Mean	11.3	11.4	12.1	12	11.4	12.7	11	8	8	8.5	11.7	10.6	128.6

Source: BOM (2016) Climate averages for Station: 066194; Commenced: 1995 – Last Record 2016; Latitude: 33.91°S; Longitude: 151.11 °E

Meteorology

Air quality impacts are influenced by meteorological conditions, primarily in the form of wind flow regimes, and by local conditions that are generally driven by topographical features and interactions with coastal influences. Figure 7.1 presents a summary of annual and seasonal wind roses for the OEH Chullora monitoring site, located approximately 1 km south west of the Chullora Site.

Of note is the low proportion of winds from the north west, and the high percentage of calm conditions (12.7% as compared to 0.6% at the CRM Site). These conditions would provide less efficient dispersion of pollutants than higher wind speeds.

Figure 7.1 Annual and seasonal wind roses for the OEH Chullora AWS

Background Air Quality

Ambient air quality is measured by OEH at a location approximately 1 km to the west of the Chullora Site. Table 7.2 presents annual average statistics for $PM_{2.5}$ and PM_{10}, whilst Figure 7.2 and Figure 7.3 present these data as a time series of 24-hour average results.

Table 7.2 Annual average statistics for $PM_{2.5}$ and PM_{10} at OEH Chullora AQMS

Pollutant	Annual Average	Units
$PM_{2.5}$	8.0	µg/m³
PM_{10}	17.5	µg/m³

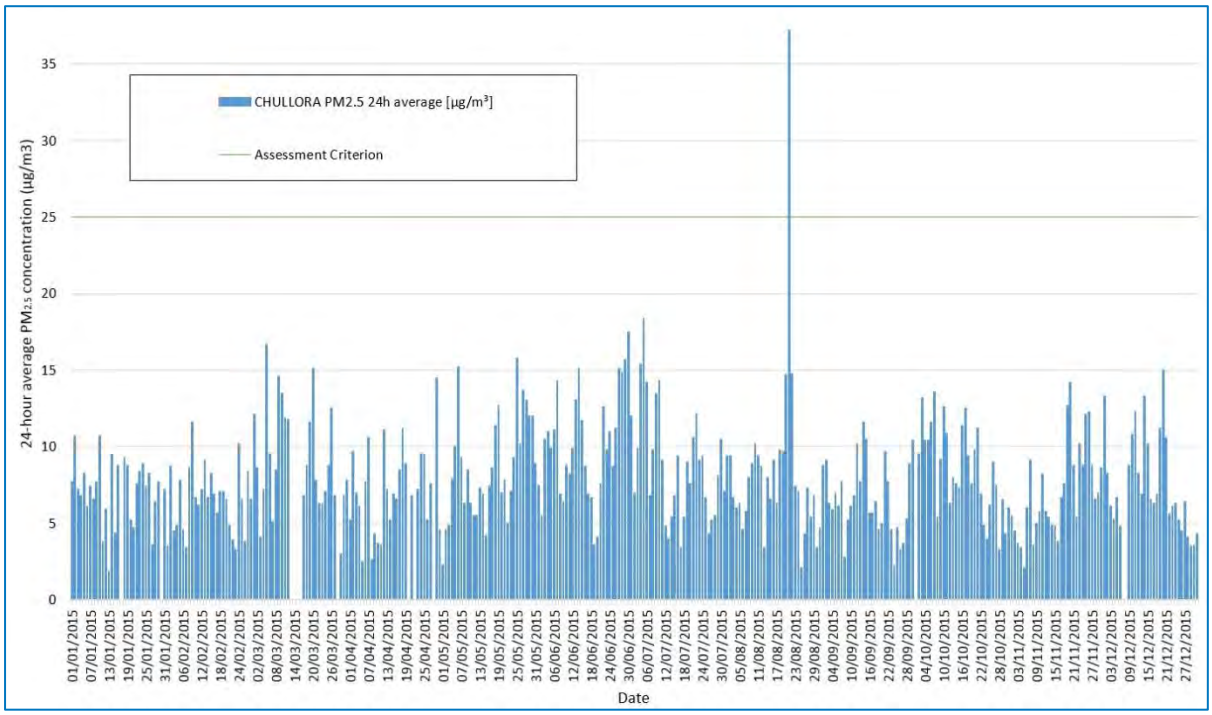


Figure 7.2 24-hour average $PM_{2.5}$ time series for OEH Chullora AQMS

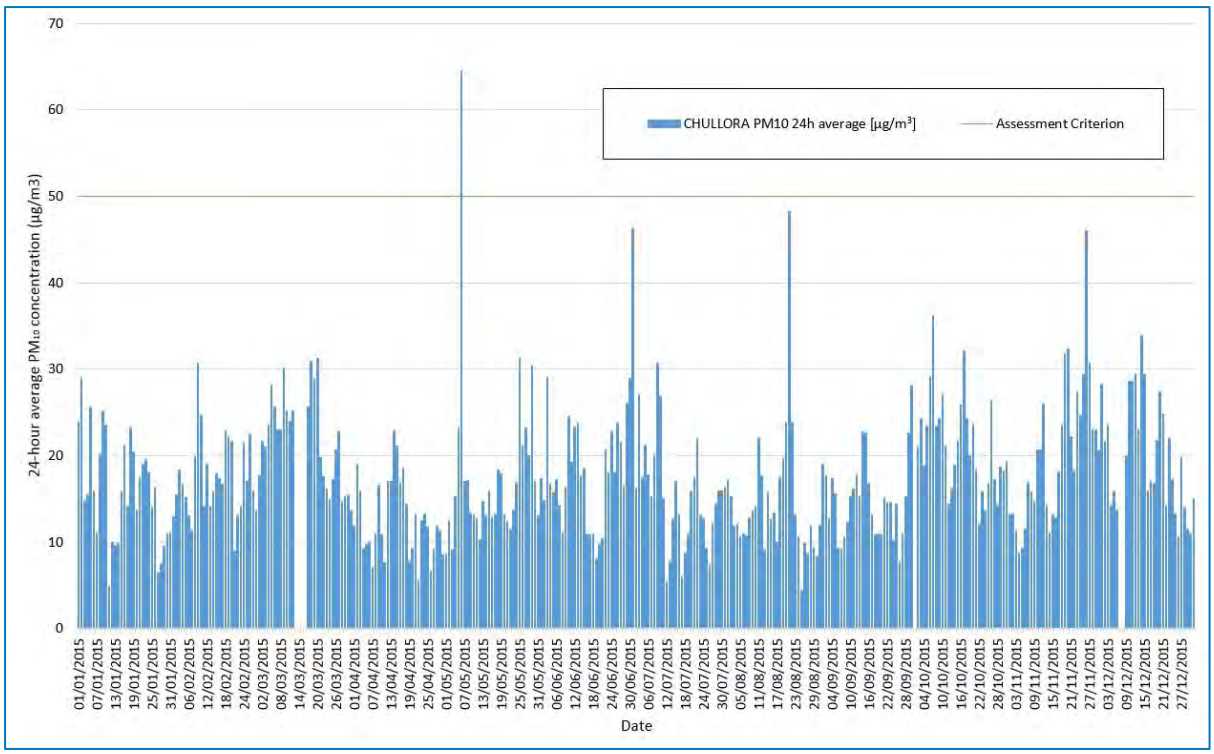


Figure 7.3 24-hour average PM_{10} time series for OEH Chullora AQMS

As shown in these figures, background PM_{10} levels are similar in scale to the CRM Site, whilst $PM_{2.5}$ levels are slightly higher.

7.2 Sensitive Receptors

The Chullora operations are located at a distance of approximately 200 m from industrial and residential receptors. The operations are proposed to occur in a hardstand area adjacent to existing rail infrastructure. Nearest residential receptors are those of Chullora situated in a medium density suburban neighbourhood adjacent to the Hume Highway.

Figure 7.4 presents an aerial image of sensitive receptors near to the Chullora site. As shown in the figure, residential receptors are present at approximately 400 m to the north east, and 200 m to the south east of the proposed operations.

Figure 7.4 Aerial image showing discrete receptor locations for the Chullora Site

7.3 Emission Potential

Section 5 provides an estimate of daily particulate matter emissions for the Chullora Site based on the implementation of the same level of controls that are applied at the CRM Site. For the purposes of considering relative emission potential, Table 7.3 presents the relative scale of Chullora and CRM Site emissions.

Table 7.3 Relative scale of Chullora and CRM Site emissions

Parameter	Particulate Class		
	TSP	PM_{10}	$PM_{2.5}$
Chullora Site emissions (kg/day)	5.2	2.7	0.8
CRM Site emissions (kg/day)	19.9	7.2	1.3
Percentage of CRM operations	26%	37%	64%

As shown in the table, Chullora PM_{10} emissions are estimated to be approximately 37% of total emissions for the CRM Site operations, whilst $PM_{2.5}$ emissions are approximately 64% of CRM Site operations.

7.4 Potential Air Quality Impacts

Given the similarity of the CRM and Chullora operations, it is considered likely that air quality impacts will be of a similar nature to those predicted near to the CRM site. Whilst there is a reduced scale of emissions at the Chullora Site, the closer proximity of sensitive receptors (200 m as compared to 300 m) implies a similar level of pollution potential. Noting this, as shown in Figure 7.1, winds from the north west (i.e. blowing from the site towards the residences) are primarily confined to winter periods. This may reduce the influence of Project emissions on nearest sensitive receptors to the south west of the Chullora Site. Also of potential importance is the higher prevalence of calm conditions at Chullora, relative to Port Kembla. This would likely be associated with an increase in near field pollutant levels in the vicinity of the Chullora Site.

8. Air Quality Management

This section presents a summary of recommended air quality management measures for the Project.

8.1 Construction Phase

Given the short duration and small scale of the proposed construction works the potential for construction to result in adverse air quality impacts is considered to be low. Noting this, it is recommended that construction air quality management be addressed via the preparation of a project-specific Construction Environmental Management Plan (CEMP) that addresses potential air quality management requirements including a consideration of:

- The potential for contamination to be present in excavations, and associated (offsite) air quality management requirements.
- Measures for the control of dust from excavation and emplacement of fill (e.g. as required for the protection of heritage rail assets). This would include measures outlined in Table 8.1
- Measures to address the potential for wind erosion from unsealed areas that are established during the construction phase.

8.2 Operational Phase

With regard to offsite air quality, the modelling analysis has indicated that particulate matter emissions are of a scale that are manageable with the implementation of effective air quality management strategies. In addition, the modelling analysis has produced the following outcomes relevant to the consideration of management requirements:

- PM_{10} is considered a key pollutant for the proposed operations.
- Emissions from haul roads and material handling operations are considered to be key potential emission sources.
- The scale of predictions within the modelling reflect implementation of the following emission controls:
    - Processing of moderate to high moisture content spoil material.
    - Enclosure of conveyor transfer/drop points.
    - Use of height adjustable (or suitably positioned) loading arms.
    - Maintenance of surface moisture content to a level that provides a 90% control efficiency against uncontrolled emissions.
    - Maintenance of unsealed areas of the site in a condition that minimises potential for soil erosion (e.g. undisturbed crusted gravel materials and vegetation).

Recognising these elements, it is recommended that these control measures be incorporated into the design and operational phases of the Project. In addition, it is recommended that a project specific Air Quality Management Plan be prepared that addresses those measures outlined in Table 8.1.

Table 8.1 Summary of management measures relevant to the Project

Activity	Management Measure

Haul truck operations	• Maintenance and cleaning of internal sealed road surfaces.
	• Application of vehicle speed limits.
	• Ensuring that vehicles are:
	  ▪ restricted to designated vehicle paths with the objective of minimising areas of erodible surface material.
	  ▪ properly maintained and operating efficiently.
	  ▪ not left with engines idling for extended periods.
	• Maintaining visual awareness of vehicle movements with the objective of identifying and addressing the presence of visible dust emissions.
	• Use of wheel wash for vehicles exiting unsealed areas of the Site.
	• Inspection and additional cleaning of undercarriage where required.
	• Ensuring that all trucks transporting soil are covered when exiting the Site.
	• Ensuring that vehicle tailgates are properly sealed, such that loose material is not deposited onto road surfaces.

Unloading to surge piles	• Maintenance of material moisture content where practical and feasible. • Maintenance of material handling equipment to operate in a proper and efficient manner.
Surge pile operations	• Minimisation of surge pile areas. • Periodic watering of surge pile areas to promote crusting of surge pile surfaces. • Application of sprays to surge piles where high winds are expected and/or present.
Wind erosion from the general Site	• Maintenance of clean road surfaces (where sealed). • Restriction of vehicles to designated vehicle paths.

9. Conclusions

The potential air quality impacts of the Project have been assessed within this report via a combination of qualitative and quantitative methods. The pollutants assessed included particulate matter as TSP, PM_{10} and $PM_{2.5}$ as well as deposited dust. Based on this assessment the following conclusions are made:

- Given the short duration and small scale of the proposed construction works the potential for construction to result in adverse air quality impacts is considered to be low. Noting this, it is recommended that construction air quality management be addressed via the preparation of a project-specific Construction Environmental Management Plan (CEMP) for each site that incorporates air quality management requirements.
- With regard to offsite air quality at the CRM site, the modelling analysis has predicted compliance with regulatory impact assessment criteria which are endorsed by NSW EPA as being protective of adverse air quality outcomes.

  Recognising these elements, it is recommended that the assessed control measures be incorporated into the design and operational phases of the Project and that a project specific Air Quality Management Plan be prepared.
- Whilst no quantitative assessment of the Chullora site has been undertaken, given the identical scale of material handling operations, as well as the absence of unsealed haul roads, it is estimated[4] that particulate matter emissions would be significantly lower at the Chullora Site.

  Noting the closer proximity of residents to the Chullora Site, it is expected that emission controls will need to be applied to an equal or greater extent than at the CRM site. Accordingly, it is recommended that an Air Quality Management Plan be developed for the operations. The plan should incorporate a quantitative analysis of potential air quality impacts, such that a determination of required emission controls can be incorporated.

[4] With the implementation of the same level of emission controls elsewhere.

10. References

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Appendix A: Sample AERMOD List File

Appendix B: Emission Source Details

Table B.1 Summary of emission source details

Volume Source	Base Elevation	Height	Initial Extent		TSP Emission Rate	Location	
	(mAHD)	(mAGL)	σy (m)	σz (m)	(g/s)	Easting (mE)	Northing (mN)
Unsealed Haul Road 1	1.91	0	9.3	2.33	0.0050	306840.8	6183337.3
Unsealed Haul Road 2	1.53	0	9.3	2.33	0.0050	306822.8	6183328.6
Unsealed Haul Road 3	1.15	0	9.3	2.33	0.0050	306804.8	6183319.9
Unsealed Haul Road 4	1	0	9.3	2.33	0.0050	306790.2	6183306.9
Unsealed Haul Road 5	1	0	9.3	2.33	0.0050	306780.9	6183289.4
Unsealed Haul Road 6	1.6	0	9.3	2.33	0.0050	306780.6	6183269.4
Unsealed Haul Road 7	1.58	0	9.3	2.33	0.0050	306787.4	6183251.0
Unsealed Haul Road 8	1.34	0	9.3	2.33	0.0050	306796.4	6183233.2
Unsealed Haul Road 9	1.1	0	9.3	2.33	0.0050	306805.4	6183215.3
Unsealed Haul Road 10	0.84	0	9.3	2.33	0.0050	306813.8	6183197.2
Unsealed Haul Road 11	0.54	0	9.3	2.33	0.0050	306821.8	6183178.9
Unsealed Haul Road 12	0.25	0	9.3	2.33	0.0050	306829.8	6183160.5
Unsealed Haul Road 13	1.55	0	9.3	2.33	0.0050	306837.7	6183142.1
Unsealed Haul Road 14	4.36	0	9.3	2.33	0.0050	306840.4	6183122.8
Unsealed Haul Road 15	5.33	0	9.3	2.33	0.0050	306832.2	6183105.2
Unsealed Haul Road 16	6.05	0	9.3	2.33	0.0050	306816.6	6183093.6
Unsealed Haul Road 17	7.11	0	9.3	2.33	0.0050	306797.4	6183089.6
Unsealed Haul Road 18	8.38	0	9.3	2.33	0.0050	306778.0	6183091.4
Unsealed Haul Road 19	9.94	0	9.3	2.33	0.0050	306759.9	6183099.7
Unsealed Haul Road 20	10.31	0	9.3	2.33	0.0050	306745.2	6183113.3
Unsealed Haul Road 21	12.2	0	9.3	2.33	0.0050	306736.4	6183130.5
Unsealed Haul Road 22	14.91	0	9.3	2.33	0.0050	306730.7	6183149.7
Unsealed Haul Road 23	17.62	0	9.3	2.33	0.0050	306725.0	6183168.8
Unsealed Haul Road 24	19.96	0	9.3	2.33	0.0050	306720.8	6183188.2
Unsealed Haul Road 25	20.98	0	9.3	2.33	0.0050	306721.9	6183208.2
Unsealed Haul Road 26	22	0	9.3	2.33	0.0050	306723.0	6183228.1
Unsealed Haul Road 27	16.01	0	9.3	2.33	0.0050	306731.0	6183246.4
Unsealed Haul Road 28	9.69	0	9.3	2.33	0.0050	306739.4	6183264.6
Unsealed Haul Road 29	3.36	0	9.3	2.33	0.0050	306747.7	6183282.7
Unsealed Haul Road 30	2.06	0	9.3	2.33	0.0050	306763.3	6183294.8
Unsealed Haul Road 31	1.48	0	9.3	2.33	0.0050	306779.8	6183306.1
Unsealed Haul Road 32	1.06	0	9.3	2.33	0.0050	306796.6	6183316.9
Unsealed Haul Road 33	1.42	0	9.3	2.33	0.0050	306814.4	6183326.1
Unsealed Haul Road 34	1.78	0	9.3	2.33	0.0050	306832.1	6183335.3
Rail dump hopper	7	0	2.326	0.465	0.0230	306900.0	6183203.3
Conveyor transfer 1	5.51	0	2.326	1	0.0230	306892.1	6183200.0
Conveyor transfer 2	0.4	3	2.326	1	0.0230	306845.7	6183179.6
Conveyor transfer 3	1.34	3	0.93	1	0.0580	306830.8	6183159.0
Locomotive exhaust 1	7.3	10	9.3	3.49	0.0012	306903.8	6183199.9
Locomotive exhaust 2	8.2	10	9.3	3.49	0.0012	306912.3	6183181.8
Locomotive exhaust 3	7.94	10	9.3	3.49	0.0012	306920.7	6183163.7
Locomotive exhaust 4	6.71	10	9.3	3.49	0.0012	306929.1	6183145.5
Locomotive exhaust 5	5.43	10	9.3	3.49	0.0012	306937.6	6183127.4
Locomotive exhaust 6	4.67	10	9.3	3.49	0.0012	306946.0	6183109.3
Locomotive exhaust 7	4.64	10	9.3	3.49	0.0012	306954.4	6183091.1
Locomotive exhaust 8	4.53	10	9.3	3.49	0.0012	306962.9	6183073.0

Locomotive exhaust 9	4.21	10	9.3	3.49	0.0012	306971.4	6183054.9
Locomotive exhaust 10	4.13	10	9.3	3.49	0.0012	306984.3	6183039.6
Locomotive exhaust 11	3.95	10	9.3	3.49	0.0012	306997.1	6183024.3
Locomotive exhaust 12	3.53	10	9.3	3.49	0.0012	307010.0	6183009.0
Locomotive exhaust 13	3.15	10	9.3	3.49	0.0012	307024.6	6182995.4
Locomotive exhaust 14	3.58	10	9.3	3.49	0.0012	307039.9	6182982.5
Locomotive exhaust 15	4.18	10	9.3	3.49	0.0012	307055.3	6182969.7
Locomotive exhaust 16	5.28	10	9.3	3.49	0.0012	307071.9	6182958.7
Locomotive exhaust 17	6.6	10	9.3	3.49	0.0012	307090.5	6182951.3
Locomotive exhaust 18	7.67	10	9.3	3.49	0.0012	307109.3	6182944.6
Locomotive exhaust 19	8.8	10	9.3	6.98	0.0012	307134.3	6182939.7
Locomotive exhaust 20	8.99	10	9.3	6.98	0.0012	307154.3	6182939.7
Locomotive exhaust 21	8.71	10	9.3	6.98	0.0012	307174.3	6182939.9
Locomotive exhaust 22	7.75	10	9.3	6.98	0.0012	307193.5	6182945.3
Locomotive exhaust 23	6.98	10	9.3	6.98	0.0012	307212.8	6182950.6
Locomotive exhaust 24	5.99	10	9.3	6.98	0.0012	307231.8	6182956.6
Locomotive exhaust 25	5.52	10	9.3	6.98	0.0012	307249.5	6182966.0
Locomotive exhaust 26	5.2	10	9.3	6.98	0.0012	307267.2	6182975.3
Locomotive exhaust 27	5.35	10	9.3	6.98	0.0012	307283.5	6182986.6
Locomotive exhaust 28	5.26	10	9.3	6.98	0.0012	307298.0	6183000.3
Locomotive exhaust 29	5.38	10	9.3	6.98	0.0012	307312.1	6183014.5
Locomotive exhaust 30	5.33	10	9.3	6.98	0.0012	307324.9	6183029.8
Locomotive exhaust 31	6.09	10	9.3	6.98	0.0012	307337.8	6183045.2
Locomotive exhaust 32	6.1	10	9.3	6.98	0.0012	307346.9	6183062.9
Locomotive exhaust 33	6.75	10	9.3	6.98	0.0012	307355.8	6183080.9
Locomotive exhaust 34	7.19	10	9.3	6.98	0.0012	307362.4	6183099.7
Locomotive exhaust 35	7.35	10	9.3	6.98	0.0012	307368.8	6183118.6
Locomotive exhaust 36	7.08	10	9.3	6.98	0.0012	307374.1	6183137.9
Surge pile area (1 of 2)	4.04	0	4.651	2.3	0.0111	306808.0	6183153.0
Surge pile area (2 of 2)	4.27	0	4.651	2.33	0.0111	306817.0	6183137.0

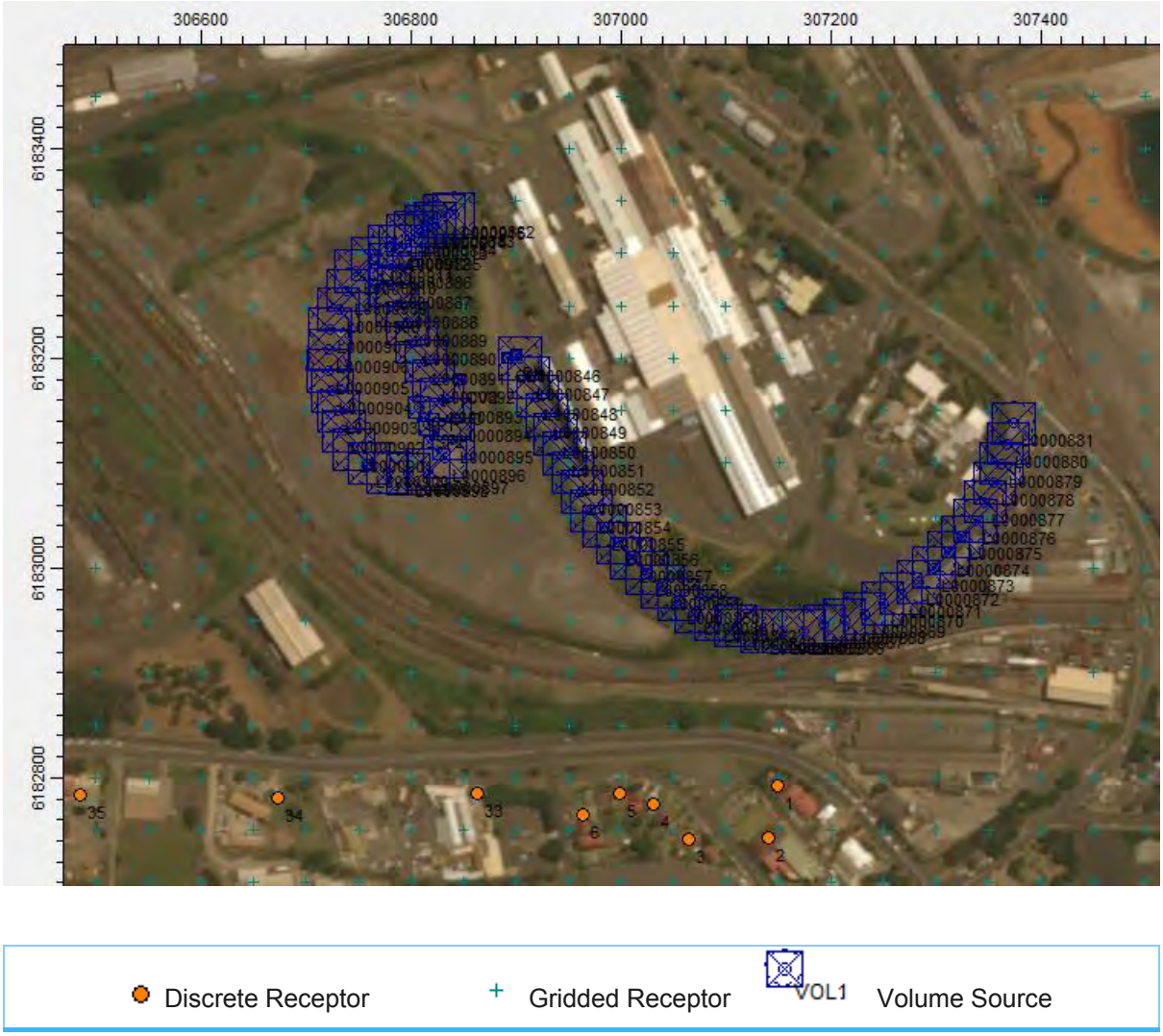

Figure B-1 Example of model configuration showing volume source array, gridded receptors and discrete receptors

Appendix 8 – Aboriginal Heritage Information Management System Search

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : 82017028-02

Client Service ID : 259810

Cardno NSW/ACT Pty Ltd - South Coast

Level 1 47 Burelli Street
Wollongong New South Wales 2500

Attention: Cassy Baxter

Email: cassy.baxter@cardno.com.au

Date: 20 December 2016

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 1, DP:DP883526 with a Buffer of 50 meters, conducted by Cassy Baxter on 20 December 2016.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
- Aboriginal objects are protected under the National Parks and Wildlife Act 1974 even if they are not recorded as a site on AHIMS.
- This search can form part of your due diligence and remains valid for 12 months.

3 Marist Place, Parramatta NSW 2150
Locked Bag 5020 Parramatta NSW 2220
Tel: (02) 9585 6380 Fax: (02) 9873 8599

ABN 30 841 387 271
Email: ahims@environment.nsw.gov.au
Web: www.environment.nsw.gov.au

AHIMS Web Services (AWS)
Search Result

Purchase Order/Reference : 82017028-02

Client Service ID : 259811

Cardno NSW/ACT Pty Ltd - South Coast

Level 1 47 Burelli Street
Wollongong New South Wales 2500

Attention: Cassy Baxter

Email: cassy.baxter@cardno.com.au

Date: 20 December 2016

Dear Sir or Madam:

AHIMS Web Service search for the following area at Lot : 1, DP:DP190251 with a Buffer of 50 meters, conducted by Cassy Baxter on 20 December 2016.

The context area of your search is shown in the map below. Please note that the map does not accurately display the exact boundaries of the search as defined in the paragraph above. The map is to be used for general reference purposes only.

A search of the Office of the Environment and Heritage AHIMS Web Services (Aboriginal Heritage Information Management System) has shown that:

0	Aboriginal sites are recorded in or near the above location.
0	Aboriginal places have been declared in or near the above location. *

If your search shows Aboriginal sites or places what should you do?

- You must do an extensive search if AHIMS has shown that there are Aboriginal sites or places recorded in the search area.
- If you are checking AHIMS as a part of your due diligence, refer to the next steps of the Due Diligence Code of practice.
- You can get further information about Aboriginal places by looking at the gazettal notice that declared it. Aboriginal places gazetted after 2001 are available on the NSW Government Gazette (http://www.nsw.gov.au/gazette) website. Gazettal notices published prior to 2001 can be obtained from Office of Environment and Heritage's Aboriginal Heritage Information Unit upon request

Important information about your AHIMS search

- The information derived from the AHIMS search is only to be used for the purpose for which it was requested. It is not be made available to the public.
- AHIMS records information about Aboriginal sites that have been provided to Office of Environment and Heritage and Aboriginal places that have been declared by the Minister;
- Information recorded on AHIMS may vary in its accuracy and may not be up to date .Location details are recorded as grid references and it is important to note that there may be errors or omissions in these recordings,
- Some parts of New South Wales have not been investigated in detail and there may be fewer records of Aboriginal sites in those areas. These areas may contain Aboriginal sites which are not recorded on AHIMS.
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